PB-215 026

AIR POLLUTION RESEARCH SEMINAR (3RD), HELD IN NEW ORLEANS, LOUISIANA ON 22-24 MARCH 1960

Public Health Service
Washington, D. C.

1960

DISTRIBUTED BY:

NTIS

National Technical Information Service
U. S. DEPARTMENT OF COMMERCE
5285 Port Royal Road, Springfield Va. 22151

PB 215 026

syllabus for the third

AIR POLLUTION RESEARCH SEMINAR

new orleans, louisiana

march 22-24, 1960

U.S. DEPARTMENT OF HEALTH,
EDUCATION, AND WELFARE
Public Health Service

Reproduced by
NATIONAL TECHNICAL
INFORMATION SERVICE

Third

AIR POLLUTION RESEARCH SEMINAR

New Orleans, Louisiana, March 22 - 24, 1960

Since passage by Congress of the first Air Pollution Research and Technical Assistance Act in 1955, the Public Health Service has sponsored a series of conferences and seminars on air pollution research. These are designed to provide a national opportunity to appraise problems and progress in this field.

U. S. DEPARTMENT OF HEALTH, EDUCATION AND WELFARE

Public Health Service

Sponsor:

The Air Pollution Engineering and Medical Programs of the Divisions of Engineering Services and Special Health Services, Bureau of State Services, United States Public Health Service

Hosts:

Louisiana State University School of Medicine
Tulane University School of Medicine
Louisiana State Board of Health
City of New Orleans Health Department

Seminar Staff:

Roy O. McCaldin, Ph.D.
Air Pollution Engineering Research
Robert A. Taft Sanitary Engineering Center
United States Public Health Service
Cincinnati 26, Ohio

Donald Green
Air Pollution Medical Program
United States Public Health Service
Washington 25, D. C.

PROGRAM

Time and Place	Subject	Speaker	Page
Tuesday Morning, March 22, 1960 L. S. U. Medical School Auditorium			
8:30 - 9:45	Registration		
9:45 - 10:00	Welcome	D. E. Price	1
10:00 - 12:00	International Aspects of Air Pollution Research		
	Moderator: L. C. McCabe Reporter : R. C. Graber		
	Continental and Global Aspects of Air Pollution	C. E. Junge	2
	Air Pollution Research in Canada	M. Katz	3
	Atmospheric Concentrations of Carbon Monoxide and Carbon Dioxide in Mexico City	E. M. Fournier d'Albe	4
	Survey of Air Pollution Research in Europe	A. C. Stern	5
	Air Pollution Research in the U.S.S.R.	B. S. Levine	6
Tuesday Afternoon, March 22, 1960			
1:30 - 4:30	Simultaneous Sessions		
	A. Sampling and Identification		
	L. S. U. Medical School Auditorium		
	Moderator: E. R. Hendrickson Reporter : J. S. Nader		
	Research and Developments on the Instrumentation of Ozone Sensing	G. M. Mast	7
	A New Method of Measuring Air Ion Mobility Distribution	J. C. Beckett	8
	Sampling Techniques	R. A. Baker	9
	Aerosol Measurements in Greenland	H. K. Weikmann	10
	Studies on Particulate Air Pollution	M. A. Fisher	11
	Characterization and Identification of Smoke and Flyash by Means of the Microscope	W. C. McCrone	12
	Particle Sizing and Analysis in Community Air Pollution Studies	H. H. Helwig	13
	Use of the Scentometer as an Odor Level Measuring Device	C. W. Gruber	14

Time and Place	Subject	Speaker	Page
Tuesday Afternoon, March 22, 1960 (Cont.)			
1:30 - 4:30	B. Meteorology Tulane Medical School, Room A-610 Moderator: G. R. Hilst Reporter : R. A. McCormick		
	Long Range Diffusion Studies at Brookhaven National Laboratory	M. E. Smith	15
	The Relationship Between Peak and Mean Concentrations	I. A. Singer	16
	An Interim Report on Full-Scale Study of Dispersion of Stack Gases	F. E. Gartrell	17
	Analysis of the Marine Layer, A Meso-Meteorological Study	S. R. Frank	18
	The Use of Constant Level Balloons as an Air Pollution Tracer	D. H. Pack	19
	Wind Tunnel Modeling of Atmospheric Diffusion	J. E. Cermak	20
	Natural Ventilation Rates over Philadelphia	R. Smith	21
	Atmospheric Dispersion of Ragweed Pollen	W. L. Hewson	22
1:30 - 4:30	C. Pulmonary Physiology State Office Building, Class Room 609 Moderator: G. F. Filley Reporter : T. R. Mazzocco		
	Effects of Atmospheric Pollutants on Susceptibility to Respiratory Infection	R. Ehrlich	23
	The Measurement of Pulmonary Function in Epidemiological Surveys	B. V. Branscomb	24
	Pulmonary Impairment from Deep Lung Irritants	J. Long	25
	Respiratory Responses to Sulfur Dioxide in Controlled Human Exposures	N. R. Frank	26
	The Pulmonary Reaction of Normal and Emphysematous Persons to the Inhalation of SO_2, Flyash & Moisture	G. W. Wright	27
	Study of the Effects of Weather and of Air Pollution in Patients with Chronic Bronchitis and Emphysema	R. L. Wilson	28

Tuesday Evening, March 22, 1960
Jung Hotel - Map Room on Second Floor

6:30 - 7:00 Cocktails

7:00 - 9:00 Banquet

Speaker: The Honorable Kenneth A. Roberts
of Alabama
United States House of Representatives

Time and Place	Subject	Speaker	Page
Wednesday Morning, March 23, 1960 L. S. U. Medical School Auditorium			
8:30 - 12:00	Effects of Air Pollution Moderator: J. C. Schwegmann Reporter : C. S. Brandt		
	Effects of Unsaturated Hydrocarbons on Crop Plants	W. C. Hall	29
	Comparison of the Effects of Air Pollutants on Tissue Cultures and on the Tissues of Intact Plants	M. Juhren	30
	Differentiating Needle Blights of White Pine in the Interpretation of Fume Damage	G. H. Hepting	31
	Air Pollutants From the Grain Industry and Allergic Asthma	H. J. Paulus	32
	Nitrogen Dioxide Poisoning in Silo Atmospheres (Silo Fillers' Disease)	L. M. Schuman	33
	The Effect of Atmospheric Fluorides on Man	R. Call	34
	Health Effects of Air Pollution on Elderly Males in Los Angeles	C. Schoettlein	35
	Unusual Corrosion Problems Due to Atmospheric Effects	H. C. McKee	36
Wednesday Afternoon, March 23, 1960			
1:30 - 4:30	Simultaneous Sessions		
	A. Engineering L. S. U. Medical School Auditorium Moderator: H. J. Weber Reporter : F. E. DeMartini		
	Inertial Impacting in Cyclone Separators	H. Binark	37
	Basic Study of Air Pollution Control Wet Scrubbers	S. Calvert	38
	Flue-Fed Incinerators for Apartment Buildings	E. P. Kaiser	39
	Air and Gas Filters for High Temperature Applications	W. J. Smith	40
	Evaluations of Air Cleaners for Occupied Spaces	K. T. Whitby	41
	Diffusion of Vented Gases Around Buildings	J. Halitsky	42

Time and Place	Subject	Speaker	Page
Wednesday Afternoon, March 23, 1960 (Cont.)			
1:30 - 4:30	B. Environmental Levels of Air Pollutants Tulane Medical School, Room A-610 Moderator: M. E. Jacobs Reporter : E. C. Tabor		
	Uptake of Fluorides by Grass Grown on Florida Soils	R. C. Specht	43
	Sampling and Identification of Kraft Pulp Mill Gaseous Effluents	D. F. Adams	44
	Variation of Different Pollutants in the Atmosphere of Mexico City	H. Bravo	45
	Results from a Continuous Monitoring Program	J. Cholak	46
	A Study of the Relationship of Street Level Carbon Monoxide Concentrations to Traffic Accidents	G. D. Clayton	47
	Relationship Between Aerial Observations and Ground Analysis of Air Pollutants	P. W. West	48
1:30 - 4:30	C. Toxicology State Office Building, Class Room 609 Moderator: D. A. Irwin Reporter : H. E. Stokinger		
	The Effects of Simulated Oxidant Type Pollutants on Microorganisms	J. H. Gast	49
	Aliphatic Nitro Compounds and Their In Vitro Biochemical Effects on Enzyme Systems	F. L. Estes	50
	The Subacute Toxicity of Several Nitro-Olefins	W. MacDonald	51
	Effects of Ozone, Sulfur Dioxide and Nitrogen Dioxide Upon Tissue Cells In Vitro	D. M. Pace	52
	Air Pollutant Effects in Mice	R. D. Boche	53
	Synergism of Aerosols	A. Goetz	54
	Survival of Rats Chronically Exposed to Sulfur Dioxide	R. M. Heyssel	55
	Phenolic Compounds in Urban Air and Their Biological Activity	R. G. Smith	56

Time and Place	Subject	Speaker	Page
Thursday Morning, March 24, 1960			
8:30 - 11:30	Simultaneous Sessions		
	A. Automotive Exhaust Research		
	L. S. U. Medical School Auditorium		
	Moderator: C. M. Heinen Reporter : A. H. Rose		
	Auto Exhaust Control	W. L. Faith	57
	Most Recent Developments in Automotive Industry Program	W. F. Sherman	58
	Legality and Legislation Regarding Control of Pollutants from Motor Vehicles	H. W. Kennedy	59
	Auto Exhaust Catalysts	W. E. Scott	60
	Noncatalytic Afterburning in Diffusion Flames of Automotive Exhaust	J. Grumer	61
	Metal Oxide Catalysts for Oxidation of Automotive Exhaust	R. B. Anderson	62
	Automotive Exhaust Studies in the United Kingdom	P. J. Lawther	63
8:30 - 11:30	B. Pathology and Pulmonary Physiology		
	Tulane Medical School, Room A-610		
	Moderator: S. B. Crepea Reporter : G. A. Fairchild		
	Potentials of Pulmonary Cytology in Evaluating Effects of Air Pollution	S. M. Farber	64
	The Relation of Environmental Factors to Pathologic Changes in the Human Trachea and Bronchi	K. P. Knutson	65
	Factors Influencing the Carcinogenicity of Inhaled Radioactive Dusts	H. Cember	66
	The Repairative Capacity of Animal Lungs After Exposure to Various Single and Multiple Doses of Nitrogen Dioxide	J. Kleinerman	67
	An Evaluation of Methods for Recognizing Changes in Airway Resistance	T. C. Lloyd	68
8:30 - 11:30	C. Chemistry		
	State Office Building, Class Room 609		
	Moderator: R. D. Hoak Reporter : J. P. Lodge		
	Desorption Products from Activated Carbon	A. Turk	69
	The Synthesis of Some Alkyl Dibenzpyrenes	F. A. Vingiello	70

Time and Place	Subject	Speaker	Page
Thursday Morning, March 24, 1960 (Cont.)			
	The Mechanism of the Oxidation of Free Radicals at 25°C and in O_2-Rich Media	J. G. Calvert	71
	A New Oxidant Irradiation Chamber	R. R. Austin	72
	Oxidation of Organic Compounds in the Atmosphere	L. A. Ripperton	73
	Reaction of Oxygen Atoms with Butadiene	R. J. Cvetanovic	74
Thursday Afternoon, March 24, 1960 L. S. U. Medical School Auditorium			
1:00 - 4:15	Community Air Pollution Studies		
	Moderator: W. W. Frye Reporter : R. Porter		
	Design of Epidemiologic Investigations of Community Air Pollution	J. J. Phair	75
	Methods and Results in the New Orleans Asthma Study	R. Lewis	76
	Establishing a State-Wide Air Sampling System	V. H. Sussman	77
	Medical Phase of the Nashville Air Pollution Study	L. D. Ziedberg	78
	Nashville Air Pollution Study, Engineering Aspects	J. J. Schueneman	79
	Community Cases of Beryllium Disease	J. Lieben	80
	California's Air Pollution Standards	J. R. Goldsmith	81
4:15 - 4:30	Seminar Closing		
	Moderator: V. G. MacKenzie F. Tetzlaff R. A. Prindle		
	Reporter : J. H. Ludwig		

ABSTRACTS OF PRESENTATIONS

"WELCOME" TO THIRD AIR POLLUTION RESEARCH SEMINAR

DR. DAVID E. PRICE

Chief, Bureau of State Services, Public Health Service
Department of Health, Education and Welfare

This is the third air pollution research seminar sponsored by the Public Health Service. The two preveious seminars held in Cincinnati in 1956 and 1958 have proven extremely valuable to the Service - and to the scientific community generally - in planning programs which are designed to fill gap areas in air pollution research. In addition, these seminars provided an opportunity for research workers to discuss recent progress in their investigations. This year the seminar emphasizes this latter point. The sessions have been arranged to allow short presentations by a maximum number of investigators, followed by an equal period for discussion by all those present. It is our sincere wish that each of the participants - even those who are not scheduled to make formal presentations - will be prepared to contribute to the discussions to the fullest extent possible. It is only through such free discussion that each of the participants will receive the full benefit of a meeting which has attracted this (most) comprehensive group of scientists from the many disciplines associated with investigations of our air pollution problems.

CONTINENTAL AND GLOBAL ASPECTS OF AIR POLLUTION

CHRISTIAN E. JUNGE

Air Force Cambridge Research Center, Laurence G. Hanscom Field, Bedford, Mass.

Except for radioactive fallout which is caused by special events, there are two atmospheric constituents the concentrations of which are increased on a global scale by industrial activities: Carbon dioxide and Sulfur dioxide.

The increase of carbon dioxide as a consequence of fuel consumption was recently much discussed and will be mentioned only briefly.

Sulfur, as a world-wide pollutant has, however, received little attention. Maps of sulfate in rain water over the U. S. indicate higher concentrations in the main industrial areas. The atmospheric sulfur budget over the U. S. shows that approximately 2-1/2 times more sulfur is released than removed over continental U. S. This excess spreads into the westwind belt of the Northern Hemisphere. On a global basis, the industrial sulfur amounts to about 30% of the total.

The industrial and natural compounds of sulfur in the atmosphere and their residence times are discussed. The role of sulfur as an atmospheric constituent is pointed out on the basis of new results from the polar and stratospheric atmosphere.

AIR POLLUTION RESEARCH IN CANADA

MORRIS KATZ

Occupational Health Division, Department of National Health and Welfare
Ottawa, Ontario, Canada

In Canada, Federal activities in atmospheric pollution have been consolidated mainly within the Occupational Health Division of the Department of National Health and Welfare since January, 1956. There is maintained close cooperation with the Meteorological Services of the Department of Transport and the meteorological requirements of the Federal program are fulfilled adequately by the direct assignment of meteorological officers to air pollution projects as the need arises. Activities of the Occupational Health Division related to laboratory services and research are distributed within two main units; (a) Environmental Assessment, and (b) Biological. These deal with a variety of problems involving air pollution and industrial hygiene activities. A brief review is presented concerning the more important aspects of air pollution research in Canada.

I. Urban or industrial air pollution surveys. Studies are in progress to evaluate the extent of air pollution from common gaseous and aerosol contaminants in Sydney, N.S.; Toronto, Hamilton, Ottawa, Sarnia, the Sudbury District and the Niagara District in Ontario; Winnipeg, Manitoba; and Vancouver, British Columbia. Various studies involving industrial emissions have been undertaken in Alberta that concern the pollution of the atmosphere by fluorides, hydrogen sulphide, sulphur dioxide and organic sulphides. Preliminary steps have been completed to initiate a survey in the City of Montreal. The pollution by arsenical waste products from gold mining and smelting in the Yellowknife District of the Northwest Territories has been under investigation for a number of years.

II. Pollution by diesel exhaust. In a cooperative study with the Canadian National Railways, the Occupational Health Division has undertaken an assessment of the components of exhaust gases from locomotive diesels under various operating conditions in relation to fuel type. Other studies relate to the composition and concentration levels of diesel exhaust gases in railway tunnels under varying traffic conditions.

III. Polycyclic hydrocarbons and other organics. An assessment is being made of carcinogenic hydrocarbons and other organic compounds in smoke and particulates of urban air, automobile and diesel exhaust gases by column, paper and other chromatographic adsorption techniques.

IV. National Sampling Network. With assistance under the Federal Health Grants, the air sampling stations maintained by provincial and municipal organizations are being organized into a national network for correlation and exchange of data.

V. Diffusion of pollutants in urban areas. Studies of this problem have been initiated with the erection of a meteorological tower equipped with appropriate instrumentation at various altitude levels in the City of Ottawa. Air sampling stations are being established at this site and in other locations within the city. The data will be correlated with an evaluation of sources within each city block. It is also planned to release known amounts of certain gases and aerosols at the meteorological site.

ATMOSPHERIC CONCENTRATIONS OF CARBON MONOXIDE AND CARBON DIOXIDE IN MEXICO CITY

E. M. FOURNIER d'ALBE AND A. P. BAEZ

Instituto De Ciencia Aplicada, Universidad Nacional Autonoma De Mexico

Continuous records of carbon monoxide concentration in the air at 3.5 meters above street level in the center of Mexico City show clearly marked variation which can be related to traffic density and meteorological conditions. Measurements made at nose level in busy streets show average concentrations varying between 15 and 40 p.p.m. depending on traffic density, with peaks reaching three times average. Outside the City concentrations are generally below 5 p.p.m.

Measurements of carbon dioxide concentrations at 3.5 meters above street level give values fluctuating between 340 and 420 p.p.m., but showing little correlation with carbon monoxide.

Finally, a series of measurements of carbon dioxide concentrations made from aircraft show highly variable values up to a height of 1000 meters above street level.

SURVEY OF AIR POLLUTION RESEARCH IN EUROPE

ARTHUR C. STERN

Robert A. Taft Sanitary Engineering Center, USPHS, Cincinnati, Ohio

In Great Britain air pollution research efforts are concentrated on the smokeless combustion of solid fuels, mainly in domestic open fireplaces; the development of smokeless fuels; the behavior of steam power plant stack plumes; the etiology of chronic bronchitis and the general problem of sulphur oxides in the air. Industrial research associations are actively studying their specific industrial air pollution problems.

In West Germany, a large research program into all aspects of air pollution is directed by a quasi-public commission headed by the German Society of Engineers (VDI). Its greatest present emphasis is on the effects of SO_2 on vegetation; the measurements of air pollution; the meteorological parameters associated with pollution dispersion; and the properties of dusts and aerosols.

Emphasis in the USSR is on the medical and control equipment aspects of the problem. Their work on the effect of individual pollutants on experimental animals and people is outstanding. Control equipment development research is a public responsibility in the several Socialist nations of Eastern Europe.

In Belgium and the Netherlands air pollution research is centered in the national technical universities; in France and Italy in the municipal health departments of Paris and Milan, respectively.

AIR POLLUTION RESEARCH IN THE U.S.S.R.

B. S. LEVINE

USPHS Research Grantee on Survey of U.S.S.R. Literature on Air Pollution
and Related Occupational Diseases

Air pollution abatement in the U.S.S.R. was initiated as a fulfillment of one of the planks of the political program of the, so called, Communist Party. Since the Great October Revolution was started by the workers and was won by them, the health and welfare of the toilers, ostensibly, were matters of primary concern. Accordingly measures for the protection of worker's health and of working conditions were recommended during the early Congresses of the, so called, Communist Party. Measures for the abatement of harmful air pollution had to be adopted at once, without waiting for the results of scientific investigation, on a temporary and arbitrary basis. With this as a background, research was begun by central and widely scattered sanitary-hygienic and occupational health institutes. Attention was centered almost entirely on workroom, shop and production plant indoor air. Regulation codes were formulated for the abatement of indoor air pollution by the joint action of health officers, research scientists and sanitary and hygienic officers, on an equally urgent, arbitrary but temporary basis, subject to revision upon the accumulation of new data derived from basic studies. The latter were presented for consideration to the Office of the Chief Sanitary Inspector of the Ministry of Health of the U.S.S.R. Almost without fail such recommendations were incorporated into the legal Code of Health Regulations.

Community air pollution prevention and abatement were initiated some years after indoor factory air pollution abatement, on an equally urgent, arbitrary, but temporary basis. Without waiting for results of time consuming investigations by scientists, limits of allowable open (atmospheric) air pollution for inhabited localities were accepted as one third of the limits adopted for factory air for corresponding pollutants. As research progressed, and rational data were accumulated, arbitrary standards were amended or replaced.

RESEARCH AND DEVELOPMENTS ON THE INSTRUMENTATION OF OZONE SENSING

GIFFORD M. MAST

Mast Development Company, Inc., Davenport, Iowa

This paper describes the most recent developments in the field of ozone sensing and monitoring with the Micro-Coulomb Ozone Sensor. It's parameters and limits of operation will be discussed. A brief description of ozone balloonsondes and dropsondes, both utilizing the M-C Sensor, will be included.

An "Ozone Meter" utilizing the M-C Ozone Sensor will be presented. This new ozone sensing and monitoring instrument promises to provide the researcher and technician in the medical and air pollution fields a new tool for their studies of ozone in low concentrations. The operation, capabilities, and possible applications of the Model 724-1 will be reviewed.

A NEW METHOD OF MEASURING AIR ION MOBILITY DISTRIBUTION

J. C. BECKETT AND ROBERT LINDSAY*

Wesix Electric Heater Company, San Francisco, California
*Stanford University, Stanford, California

The measurement of air ion mobility distribution offers another index of air pollution. A new method automatically measures, differentiates and records air ions having mobilities ranging from 4 to .002 cm/sec/volt/cm. Ten minutes are required for each complete sample, using a 15-second interval for each step of a selected mobility range. The method uses a standard parallel plate type ion collector, an ion trap to selectively remove high mobility ions in predetermined steps, a 50 point stepping switch for automatic operation, a micro-microammeter and a strip chart recorder operating at a chart spread of two inches per minute.

Ordinary clean air contains predominantly small ions having a mobility greater than 0.1 cm/sec/volt/cm. Typical urban air pollution will depress the small ions and increase the number of intermediate ions in the mobility range between 0.1 and .002 (.003 to 0.05 microns). Using a radioactive (tritium) ion generator for preionizing the air sample simplifies measurements and reduces sensitivity of the equipment required.

With sufficient collection of data it may be possible to identify submicroscopic pollutants by the mobility spectrum that they produce. Many samples will be required, however, before the practical application of this suggestion can be fully evaluated.

SAMPLING TECHNIQUES

ROBERT A. BAKER

Laboratories for Research and Development, The Franklin Institute, Philadelphia, Pennsylvania

This study was made to determine the effect of various storage techniques and materials on known concentrations of gases in air. These gases were studied as single components and as complex mixtures under atmospheric and compression storage conditions. Storage was in steel cylinders, plastic bags and glass flasks at varying time intervals. Results were monitored by infrared spectrometry and by gas chromatographic procedures.

Compression storage in steel cylinders at 150 psig resulted in high loss of sulfur dioxide and nitrogen dioxide, but little hydrocarbon loss. The compressor was found to affect the mineral oxides especially sulfur dioxide. This technique appears satisfactory for hydrocarbons.

Various polymeric films were fabricated into bags and evaluated as gas storage containers at atmospheric pressure. Moisture, regardless of whether present originally or having permeated into the bag on storage, was a major factor. Mineral oxides disappearance is more rapid at high relative humidity. Hydrocarbons were not similarly influenced. Chemical reaction and permeability are involved with the soluble mineral oxides but diffusional parameters alone control hydrocarbon loss. These statements apply only if the gases are nonreactive with the plastics.

Two-film bags may be useful in field testing. The inner film should be impermeable to the gases of interest and the outer film to moisture. Aluminized-Mylar was the least permeable to moisture of the plastic films studied. Additional study under conditions of controlled humidity are contemplated to define comparative performance of the films.

Gas-liquid chromatography and plastic bags offer potential benefits in field testing of air pollution. Small volumes at low concentrations may be accurately measured if the specific analytical procedure is available.

The occurrence of a dark reaction could not be demonstrated after 46 hours storage of a mixture of sulfur dioxide, nitrogen dioxide and 2-pentene. Measurement was by light scattering.

Storage of the sulfur dioxide, nitrogen dioxide, 2-pentene mixture in steel cylinders at atmospheric pressure showed no significant loss. Comparable storage in glass flasks showed high loss of sulfur and nitrogen dioxides.

AEROSOL MEASUREMENTS IN GREENLAND

H. K. WEICKMANN AND R. FENN

U. S. Army Signal Research and Development Laboratory, Fort Monmouth, New Jersey

Measurements of the particle concentration in northern Greenland in areas near the coast and in the interior were carried out in July 1957, March 1958, August 1958, and August 1959. The results indicate that in summer near the coast and over permafrost soil their number in the size range from 10^{-7} to 10^{-4} cm varies from less than 100 to more than 1000 per cubic centimeter. Over the ice cap, 220 miles away from the coast and upwind of sources of contamination, the concentration is so low that special instrumentation is necessary for detection. Measurements with the Goetz spectrometer indicated a concentration of 1 to 3 particles per cubic centimeter in a narrow size range of around one micron diameter.

STUDIES ON PARTICULATE AIR POLLUTION

MORRIS A. FISHER

Armour Research Foundation of Illinois Institute of Technology, Chicago, Illinois

Research on particulate air pollution is discussed in terms of the problems of sampling, analysis, and correlation of data. The development of effective means for the assessment of particulate air pollution requires more reliable generalizations on the behavior of atmospheric particulates. This, in turn, depends on more detailed knowledge of the properties of the particles.

These problems are discussed in relation to brief summaries of the following current or recent investigations in our laboratories:

1. Particle counts and size measurements with the light-scattering single particle counter.

2. Directional sampling of suspended dust.

3. Electrostatic precipitator for sampling and quantitative size separation.

4. Studies of radioactive fallout - size separation of dry fallout, and interactions of small particles with a water drop.

CHARACTERIZATION AND IDENTIFICATION OF SMOKE AND FLYASH BY MEANS OF THE MICROSCOPE

WALTER C. McCRONE

Walter C. McCrone Associates, Chicago, Illinois

A U. S. Public Health Service Research Grant is under way to characterize by microscopic morphology the various types of particulate air pollutants. The objective is to photograph, under standard conditions, as many as possible of the different types of particles, e.g., wind erosion products, industrial dusts and combustion products.

The latter represent a stiff challenge for the microscopist and it is only now beginning to be apparent that the different sources of smoke and flyash can be unequivocally identified. The microscopic morphology of smoke and flyash particles varies depending on the:

1. type of fuel, e.g., gas, coal, oil, wood, trash
2. type of equipment, e.g., open fire, diesel engine, steam locomotive, mechanical stoker, pulverized fuel boiler, domestic furnace or stove, etc.
3. type of operation, e.g., air supply, burning rate, load, blowing of tubes, cleaning fires, etc.

Fortunately any variation in these three factors causes a significant change in the morphology of the resulting particles. Photomicrographs will be shown illustrating the effect of a number of the above variables.

When completed, this project will give the answers to questions such as the following:

1. What percentage of smoke and flyash is contributed by homes, industry, incinerators, etc.?
2. What is the geographical distribution of flyash from a given industrial stack?
3. What is the percentage of smoke and flyash in total settled or suspended dust samples?
4. How efficiently is a given industrial stack operating?

PARTICLE SIZING AND ANALYSIS IN COMMUNITY AIR POLLUTION STUDIES

HAROLD L. HELWIG

State of California Department of Public Health, Berkeley, California

Knowledge of chemical and physical characteristics of airborne particles associated with community air pollution is essential for the elucidation of several questions about air pollution and its effects. Emphasis in our current and proposed studies is placed upon obtaining data on the size and composition of particles in polluted air which may be useful for:

1. Indicating the involvement of particles in atmospheric reactions by observations of the characteristics of particles associated with the formation and decay of the photochemical air pollution complex;

2. Assessing the contribution of sources of pollutants to the air pollution problem by comparative studies of particles from known sources and particles existing in the air pollution complex;

3. Designing studies of known systems which closely simulate those occurring in the ambient atmosphere based on observations of particles which exist in polluted air, and

4. Evaluating the potential of particulate pollutants to penetrate and be deposited in the human respiratory tract, and to deposit particle-borne toxicants.

The collection of accurate data on the size and composition of airborne particles is dependent upon the availability of instrumentation for collecting and sizing with minimal alteration of the properties of the particles and the availability of sensitive analytical methods. The development of the aerosol spectrometer provides an instrument which is suitable for use in the field and which collects and sizes submicron particles with minimal change of chemical and physical properties. Investigations of the performance characteristics of this instrument have evaluated the air flow characteristics and collection efficiency for submicron particles. A modification of the instrument to reduce bypass flow has been made. Methods have been developed for the generation of monodisperse aerosols for use in calibration of particle sizing instruments.

Developmental work needed for particle collection, sizing and analysis for proposed studies of fine particles in community air pollution situations will be discussed.

USE OF THE SCENTOMETER AS AN ODOR LEVEL MEASURING DEVICE

CHARLES W. GRUBER

Air Pollution Control and Heating Inspection, Department of Safety
City of Cincinnati, Ohio

Word descriptions of nuisances in air pollution ordinance regulations are subject to much argumentative interpretation. This is particularly true when dealing with odor nuisance. What one person may tolerate as "not bad", another complains about violently.

In order to bring about a more definitive description of an odor situation, an instrument called the "Scentometer" has been constructed to permit an observer to determine a threshold concentration in the midst of an ambient odor situation. This is an organoleptic measurement device using the principle of vapor dilution. The instrument is portable and utilizes the human respiratory system as the source of suction. Activated carbon beds furnish the "odorless" air supply which is blended with odorous air through a system of calibrated orifices.

Field measurements have been made with the instrument and results have been reported in whole numbers as "Dilutions to Threshold", (D/T) by the observer.

LONG-RANGE DIFFUSION STUDIES AT BROOKHAVEN NATIONAL LABORATORY

MAYNARD E. SMITH

Brookhaven National Laboratory, Upton, L.I., New York

Field tests of diffusion at large distances from the source require either an extensive array of fixed samplers, or extreme mobility if only one sampler is used. Brookhaven National Laboratory has recently developed two fast-response sampling units for use with light aircraft. One measures oil-fog concentrations and the other radioactivity, but both record their data on a simple, effective tape recording system. While some of the data derived from the studies are discussed, the main objective of the paper is to describe the sampling methods and to examine both their advantages and shortcomings.

THE RELATIONSHIP BETWEEN PEAK AND MEAN CONCENTRATIONS

IRVING A. SINGER

Brookhaven National Laboratory, Upton, L.I., New York

Many aspects of meteorology relating to average air pollution concentration values are well understood in terms of practical problems. However, the value of meteorological parameters in the prediction of short-term concentration fluctuations is relatively unknown. Since such concentration peaks can be more than an order of magnitude greater than the average values, they are of considerable importance in air pollution. This paper includes a description of a field technique which permits study of such fluctuations, and a preliminary statistical analysis of peak/mean concentration ratios as a function of meteorological conditions.

AN INTERIM REPORT ON FULL-SCALE STUDY OF DISPERSION OF STACK GASES

F. E. GARTRELL

Tennessee Valley Authority, Chattanooga, Tennessee

In the period 1953-1956 the Titrilog was adapted for operation in a helicopter to supplement ground based monitoring instruments, Thomas autometers. Techniques were developed for defining the SO_2 concentration and the geometry of plumes from large coal-burning steam plants. In 1957 a three-year, full-scale study of dispersion of stack gases was undertaken under a research contract with the U. S. Public Health Service. This report summarizes findings to date.

With assistance provided by U. S. Weather Bureau meteorologists assigned to the U. S. Public Health Service, Air Pollution Engineering Research Program, TVA has carried out extensive aerial sampling to define dispersion of power plant plumes. Twenty-four series of sampling flights, each of about three hours, have been made in inversion and high wind conditions. On two occasions attempts were made to define dispersion in periods when low velocity winds and a looping unstable plume existed.

Data obtained include SO_2 profile charts of various plume cross sections; plant operational data; relative humidity, wind records, and lapse from a field meteorological station; wind direction and velocity data from pibal observations up to elevation 3000-4000 feet; and vertical temperature profile by aerial sounding from ground level to about 500 feet above the maximum plume elevation.

Preliminary analyses have been made of field data. Utilizing plots of SO_2 concentrations in successive plume cross sections, values of the diffusion parameter "n" and coefficients "C_y" and "C_z" of the Sutton diffusion equations have been determined. An unexpected finding has been a substantial decrease in the total SO_2 flux in successive plume cross sections. Decreases in the order of 20-40 percent have been noted in distances of 1 to 6 miles and time periods of 60-80 minutes. The magnitude and variation of this loss of SO_2 flux posed a question as to its effect on diffusion parameters derived from atmospheric measurements of SO_2 made with the Titrilog. One possible explanation for the apparent "loss of SO_2" is that sulfur dioxide might be converted in the atmosphere to sulfur compounds such as sulfuric acid which would not be recorded by the Titrilog.

To check on this possibility facilities were constructed in the latter half of 1959 for the controlled dilution and cooling of flue gas with concurrent sampling and analyses to measure the extent of oxidation of sulfur dioxide. In this study air aspirators conveyed gas direct from a steam plant flue through a short heated conduit into a large trailer where moderate control of dilution, detention, and cooling was possible. Data have not been fully analyzed but preliminary appraisal indicates that the rates of loss of sulfur dioxide through oxidation observed in the dilution chamber are in the same order of magnitude as those observed in the plume. Measurements of rates of oxidation of SO_2 in the atmosphere by aerial sampling are planned.

ANALYSIS OF THE MARINE LAYER, A MESO-METEOROLOGICAL STUDY

SIDNEY R. FRANK

Aerometric Research, Inc., Goleta, California

The investigation of the kinematic and thermodynamic characteristics of the Marine layer along the Santa Barbara Coast has been undertaken by Aerometric Research Inc. for the prime purpose of determining the fine structure of the low level inversion.

To circumvent one of the major difficulties in fine scale analyses, namely, installation of optimum instrumentation networks, it was decided to utilize photographic techniques using smoke particles as visible tracers of air movement. Special camera devices were developed by North American Weather Consultants, and these were used in the field experiments. Initial results were sufficiently encouraging to warrant expansion of the photographic approach toward the solution of auxiliary problems inherent in the basic project. Meteorological documentation of all field tests was made concurrently with the photographic studies and will be integrated in the final analysis of the film records.

THE USE OF CONSTANT LEVEL BALLOONS AS AN AIR POLLUTION TRACER

DONALD H. PACK

Special Projects Section, Office of Meteorological Research, U. S. Weather Bureau

A brief resume of the development of small constant level balloons suitable for precision tracking by radar is presented. Trajectories of more than 10 such flights are shown together with height and wind speed variation determined from the individual radar positions.

The possible use of such tracers in air pollution studies is discussed and some of the operational techniques and problems are described.

WIND TUNNEL MODELING OF ATMOSPHERIC DIFFUSION

J. E. CERMAK

Department of Civil Engineering, Colorado State University, Fort Collins, Colorado

Diffusion from a point source located within the turbulent boundary layer created by the floor of a 6 x 6 x 20 ft. wind tunnel test section is being systematically studied. Quantitative data pertaining to the effects of surface roughness, vertical temperature gradients and source location upon the resulting diffusion phenomena are being collected.

Using ammonia as the contaminant gas, the downstream mean concentration field is mapped by withdrawing the ammonia-air mixture through a needle sampling probe. Upon bubbling a definite volume of the mixture through an acid solution, the concentration of ammonia is determined colorimetrically after addition of Nessler's reagent. Hot-wire anemometry is used to determine the turbulence characteristics -- intensity and scale -- of the diffusion field.

An attempt to relate the geometrical properties of the wind-tunnel concentration fields to those associated with the concentration fields measured in Project Prairie Grass is being made. Data are being studied to determine if the length scaling of the concentration field is determined by the Eulerian time scales of the atmospheric surface layer and the wind-tunnel boundary layer.

NATURAL VENTILATION RATES OVER PHILADELPHIA

RAYMOND SMITH

Air Pollution Control Section, Dept. of Public Health, City of Philadelphia, Pa.

The greater Philadelphia metropolitan area bears certain similarities to Los Angeles County. The area contains about 4.5 million people and occupies about 4,000 square miles. The amount of oil refined is almost identical. Factors relating to fuel usage; transportation; and most important, meteorology and topography are quite different. Los Angeles type smog has been observed periodically in the area. Philadelphia City incorporates approximately half of the population of the area in 130 square miles.

A study of the community's natural ventilation rates was initiated in 1959. This study in conjunction with limited atmospheric sampling for particulate matter and limited source surveys is to provide information for the following:

1. Define acute minimal ventilation periods and the extent of their concentrating effect on air pollution.

2. Correlate sampling data with meteorological conditions to ascertain the weather patterns associated with problem periods.

3. Provide information on diffusion constants which might then be used with existing but limited data on community mass emission rates for estimates of gross mass emission rates.

Auxiliary benefits of the study may be the provision of guidance in community planning and the orientation of future sampling stations. Of even greater importance may be the possibility of base lines for tolerable average concentrations of air pollutions based on maximum allowable concentrations for minimal ventilation periods.

Preliminary results indicate that previous concepts of prevailing winds and their influence on the community's air pollution problems had been completely erroneous. Furthermore, the frequency of occurrence of problem periods had been grossly underestimated.

The study has also directed our attention to the rather large and statistically significant depression of air-borne dust on weekends as compared to weekdays. When a nominal background concentration is subtracted from the observed concentrations, the difference approximates 30% and correlates with the decrease in industrial activity and traffic density.

ATMOSPHERIC DISPERSION OF RAGWEED POLLEN

E. WENDELL HEWSON

Meteorological Laboratories, University of Michigan, Ann Arbor, Michigan

Analysis of pollen emission from ragweed plants is continuing. New information has been obtained on the time and nature of flower development during the growing season. Pollen emission has been shown to have a secondary peak in the late afternoon and early evening in addition to the primary morning maximum.

Criteria are being established for the prediction of pollen concentrations, both on a daily and seasonal basis. First the time of occurrence, shape, and magnitude of peak values of the mean seasonal distribution of concentrations must be predicted, and daily deviations from the mean seasonal curve must then be forecast. The daily concentration predictions are based on statistical correlations with weather elements which may be forecast with satisfactory accuracy by established methods. The day - degree technique which has been successful in predicting the ripening of garden and cereal crops is being employed to forecast the seasonal pollen distribution. During the past 14 years the date of occurrence of peak concentrations for the season has ranged from August 24 to September 5. The presentation concludes with a brief discussion of the public health benefits to be expected from a program of seasonal and daily forecasts of ragweed pollen concentrations.

EFFECTS OF ATMOSPHERIC POLLUTANTS ON SUSCEPTIBILITY TO RESPIRATORY INFECTION

RICHARD EHRLICH, SOL MILLER, AND M. R. PURVIS

Biological Research Section, Armour Research Foundation, Chicago, Illinois

A research program is carried out to determine the effects of atmospheric pollutants on the susceptibility to respiratory infections. The specific pollutant used during the present phase of the investigation is ozone and the microorganisms causing the infection is Klebsiella pneumoniae. In the preliminary phase of the program the virulence and viability studies of the organism were conducted to determine the LD_{50} for mice. In the following phases studies will be conducted on the effects which ozone exerts on animals. The expiremental conditions include exposure of swiss albino mice to the atmospheric pollutants prior to the challenge with bacterial aerosol and aerosol challenge prior to exposure to the pollutants.

Experimental results obtained to date as well as the apparatus and techniques used will be discussed.

THE MEASUREMENT OF PULMONARY FUNCTION IN EPIDEMIOLOGIC SURVEYS

BEN V. BRANSCOMB

Department of Medicine, The University of Alabama Medical Center, Birmingham, Alabama

The measurement of pulmonary function in epidemiologic surveys has been complicated by the lack of techniques both practical for field use and sufficiently sensitive to find early alterations of pulmonary function. Field tests were made in which the Wright Peak Flow Meter, McKesson Vitalor, Monaghan Puff Meter, Collins 13 1/2 liter spirometer, and a special high frequency spirometer with oscilloscopic recorder were made. These devices were installed in a bus in which twenty-four different measurements were carried out on volunteers. The studies included maximal inspiratory and expiratory efforts with air flow recorded in relation to volume within the vital capacity. These "maximum flow-volume" loops could be obtained in duplicate in about three (3) minutes per subject, were found to be easy to calibrate and to analyze. From these loops all the measurements available from the other pieces of apparatus - except the maximum breathing capacity - could be calculated. In some individuals whose maximum breathing capacities, peak flow rates, and other conventional ventilatory measurements were normal, the contour of the flow-volume loop was abnormal. These changes were attributed to increased airway resistance suggestive of early pulmonary disease. The findings suggest that flow-volume loops provide much more information than other types of ventilatory measurements and may identify early lung disease not apparent from other measurements. The apparatus is adaptable to epidemiologic surveys and can be used in conjunction with portable X-ray units.

PULMONARY IMPAIRMENT FROM DEEP LUNG IRRITANTS

JAMES E. LONG

Department of Occupational Health, University of Pittsburgh, Pittsburgh, Pa.

Groups of rats were exposed to nitrogen dioxide at concentration levels producing 25-30 per cent mortality. Starting several hours after the exposure to give time for development of pulmonary edema in the surviving animals, these groups were exposed to sulfur dioxide, sulfur dioxide plus sodium chloride aerosol and sulfur dioxide plus sulfuric acid mist. Similar experiments were conducted in which phosgene was substituted for nitrogen dioxide. These "secondary insult" exposures failed to indicate any potentiating effect either in respect to the overall mortality or in the mortality-time experience.

Utilizing an apparatus designed to assess the diffusion capacity of small animals, the rate of respiratory uptake of carbon monoxide-C^{14} was measured at hourly intervals following 30-minute exposures to phosgene at concentration levels ranging from one-half to five times the M.A.C. for phosgene. Some change was observed in the index of diffusion in rats exposed to 0.7-2.0 ppm and the magnitude of impairment increased sharply above 2.0 ppm.

RESPIRATORY RESPONSES TO SULFUR DIOXIDE IN CONTROLLED HUMAN EXPOSURES

N. R. FRANK, MARY O. AMDUR, JAY BARTLETT AND JAMES L. WHITTENBERGER

Department of Physiology, Harvard School of Public Health, Boston, Massachusetts

SO_2 has been shown to increase pulmonary flow resistance (PFR) in unanesthetized guinea pigs (Amdur, M. O., Am. Ind. Hyg. Assoc. Quar. 18: 149, 1957); this change becomes greater when the gas is given in combination with saline aerosol. We have compared the effect of SO_2 alone, and when combined with aerosol, on the respiratory mechanics of healthy human subjects. The measurements were made using an esophageal catheter and a body plethysmograph. Thirteen subjects (ages: 21-57) were exposed 26 times to concentrations of gas ranging from 1 to 20 ppm; the aerosol averaged 7.7 mgm./m^3 (range: 5.6 - 12.0 mgm./m^3); each exposure lasted about 10 minutes. During exposure to SO_2 alone, there was no essential change in mean PFR at concentrations of 1-2 ppm (-7%; range: -14 to +2, expressed as $\frac{\text{control - exposure}}{\text{control}} \times 100$). At 4-5 ppm, mean PFR rose 19% (range: +3 to +52%) while over the range of 8-19 ppm it rose 49% (range: +11 to +100%); the average response to aerosol plus SO_2 in concentrations of 8-20 ppm was slightly higher than for the gas alone; 72% (range: +13 to +163%).

A comparison was also made during similar exposures to SO_2, of the response of airway resistance alone (DuBois), PFR (airway plus pulmonary tissue), and, finally, thoracic cage plus PFR (Mead).

THE PULMONARY REACTION OF NORMAL AND EMPHYSEMATOUS PERSONS TO THE INHALATION OF SO_2, FLY ASH, AND MOISTURE

GEORGE W. WRIGHT AND THOMAS LLOYD

Department of Medical Research, Saint Luke's Hospital, Cleveland, Ohio

Eight normal men and four persons having diffuse obstructive emphysema comprised the study group. The subject sat for 20 to 25 minutes in a chamber for each exposure. SO_2 concentrations were 2.5, 5.5, 10, and 23 ppm. Particulates less than 10 microns in size varied from 6 to 1.2 million particles per cubic foot. No measurements of water particles were made, water aerosol simply being added to the ambient air when desired. The following measurements were made before and as soon as possible after the gas exposures:

Airway resistance (Plethysmograph), maximum and maximum mid expiratory flow rates, maximum breathing capacity, timed vital capacity, pulmonary volumina (closed circuit nitrogen), ventilation effectiveness (closed circuit nitrogen) were measured before and within 20 minutes after exposure.

The normal subjects showed no trend as to resistance changes consequent to exposure. One individual consistently demonstrated an increase, and another a decrease after each exposure. None of the variations following the exposure were greater than hour to hour or day to day variations of control non-exposed persons. No systematic fluctuations related to any of the various combinations of exposures were observed in the other measurements made in the eight normal persons. Four men having classical clinical and physiologic evidences of diffuse obstructive emphysema were exposed for 20 minutes to 5 ppm. SO_2, 6.0 mpcf. and added water aerosol. The maximum breathing capacities of these four men were as follows: 56, 32, 28, and 20 liters per minute. Each individual demonstrated a decrease in the airway resistance, and no change in the other measurements following the exposure.

STUDY OF THE EFFECTS OF WEATHER AND OF AIR POLLUTION IN PATIENTS WITH CHRONIC BRONCHITIS AND EMPHYSEMA

ROGER H. L. WILSON AND NANCY L. WILSON

University of California Medical Center, San Francisco, California

This report is based on a series of well-stabilized patients with emphysema and bronchitis, studied at intervals over a period of nearly 3 years. They all are from a sporadically polluted area in San Francisco. Studies were limited to simple ventilatory tests; as well as keeping a diary. The relationship between worsening of ventilatory tests and a relatively low ambient pollution level higher than the average in the community appears well demonstrated. This implies an immediate irritant effect separable from the Los Angeles studies of Motley et al. The factors of sky cover, humidity and mean temperature appear necessary to implicate in these changes. To lend further force to the association, double blind studies with bronchodilators and cough suppressors show a suggestive reversal of the adverse pattern.

Factors behind this are discussed with particular reference to mouth breathing on exertion in this group of patients, and the peculiar sensitivity of the bronchial tree in the presence of gross respiratory insufficiency. It is suggested that the acute changes in a community with sporadic air pollution may represent the beginning of a pattern of worsening unfavorable in such patients requiring considerable medical attention to overcome. From these preliminary observations, a pattern of study has been evolved for future development.

EFFECTS OF UNSATURATED HYDROCARBONS ON CROP PLANTS

WAYNE C. HALL AND WALTER W. HECK

Texas Agricultural and Mechanical College, College Station, Texas

Damage to cotton and other crops in the vicinity of a Gulf coast polyethylene plant has led to studies on the causative agent or agents responsible for crop losses. Responses exhibited by both native and cultivated plants of the area led to an initial diagnosis that the symptoms were caused by ethylene present in relatively high amounts in the atmosphere. Analysis of the stack gas showed 1.5% ethylene, 0.3% ethane, 8.7% carbon dioxide, 0.3% ethylene oxide and minute amounts of methane. Field analyses have shown concentrations of ethylene ranging from 0.04 to 3 ppm depending upon atmospheric conditions (wind direction and velocity) as well as distance from the polyethylene plant.

Various mixtures of hydrocarbon gases have been tested using cotton, coleus, tomato and other plant species. Ethylene has been found to be the most biologically active of the hydrocarbon gases studied. Controlled experiments have confirmed field observations that monocotyledonous plants such as sorghum and corn are relatively insensitive toethylene, whereas dicotylendonous plants such as cotton, coleus, corn, pea and tomato are extremely sensitive. Flower petal abscission in periwinkle and flower bud (square) abscission in cotton have been found to be excellent "indicators" of extremely low levels of ethylene air pollution in both the field and in controlled experiments. Typical responses of cotton to low levels of ethylene include: loss of apical dominance with the resulting prostrate growth habit, flattening of upper stem and growing point, forcing of lateral buds, weakening of main stem, compacting of internodes, earlier and more profuse flowering with the abscission of squares, total loss of yield.

Controlled experiments have been designed to: identify the immediate causative agent and determine if other hydrocarbon gases, in concentrations typical of air pollutants, have an effect on plant growth; find plant species which are resistant to the gases - especially crop or potential crop plants; select out and use "indicator" plants; develop means of diagnosing air pollutants at a concentration below that causing visual plant symptoms but possibly still causing a decrease in plant production.

COMPARISON OF THE EFFECTS OF AIR POLLUTANTS ON TISSUE CULTURES AND ON THE TISSUES OF INTACT PLANTS

MARCELLA JUHREN, WM. S. STEWARD AND W. N. NOBLE

Los Angeles State and County Arboretum, Arcadia, California

To compare the effect of air pollutants on the tissues of intact plants with their effect on plant tissue cultures, smoggy air, SO_2 and ozone were drawn at a relatively fast rate through small chambers containing whole plants and several types of tissue cultures. These were: (1) Tomato root cultures. The effect of the atmospheric air on a day when the oxidant level measured by the phenolphthalin method reached .5 ppm. was to increase the initiation of tertiary rootlets. (Smog treated root cultures developed more than twice as many rootlets as did controls). In light smog, tomato plants were observed to increase their uptake of CO_2, within 5 minutes after exposure. However, in heavy smog (.5 ppm.) the CO_2 uptake was decreased. (2) Cultures of a normal tomato seedling epicotyl about 4 mm. in length. These formed leaves and ultimately roots. In a culture which was predominately leafy, young leaves showed damage when exposed to smog (oxidant .4 ppm.). The leaf mesophyll cells appeared shrunken, but less so than the mesophyll cells of a damaged whole plant. (3) Callus cultures of smog-sensitive strains of tobacco. These cultures contain large undifferentiated cells which gave no evidence of injury in smog, in ozone at .7 ppm., nor in SO_2 in dilutions ranging from 1 to 7 ppm. Some of the cultures developed chlorophyll and even small leaves. These also showed no injury. Whole plants in the same chamber were severely injured. When cultures were handled aseptically and grown afterward in replications of twenty, they showed no changes in growth characteristics.

DIFFERENTIATING NEEDLE BLIGHTS OF WHITE PINE IN THE INTERPRETATION OF FUME DAMAGE

GEORGE H. HEPTING

Division of Forest Disease Research, Southeastern Forest Experiment Station,
U.S. Department of Agriculture, Forest Service, Asheville, N. C.

Eastern white pine is subject to many foliage troubles that can be confused with fume damage. Both eastern and western white pine are regarded as sensitive to such pollutants as sulfur dioxide and fluorine. In the southern Appalachians at least six disease entities can produce foliage effects that at some stage can be confused with each other.

Bifusella linearis blight appears on the second or third year foliage as a die-back, with the dead parts bearing easily identified large black elongate fungus pustules.

The brown spot disease can brown needle tips by the first winter. Necrosis spreads down the needles. There is a copious shedding of affected needles, often in their second year. Small black fungus pustules form on affected needles.

A dying of the distal parts of current needles only during their period of elongation in the spring is called emergence tipburn. It has been studied for over 50 years, occurring periodically from Canada to Georgia, with no apparent relation to a needle pathogen, needle insect, or air pollution.

Heavy accidental localized fumigation with toxic gases can produce a post-emergence acute tipburn, involving a sudden browning of some or all of the foliage at any time of year, often followed by heavy needle shedding.

The term post-emergence chronic tipburn is applied to a condition that may be related to stack gas from soft coal-burning plants, but such a relation has not been proven. The symptoms differ from those of emergence tipburn in that the needle browning may appear at any time of year rather than only during the growing season, and there is a gradual dieback with a gradient from brown at the tip to green at the base, whereas in the emergence type the line of separation is sharp. Shoot growth diminishes and mortality is common.

The last entity is an irregular tipburn associated with large numbers of shoot and needle aphids.

AIR POLLUTANTS FROM THE GRAIN INDUSTRY AND ALLERGIC ASTHMA

HAROLD J. PAULUS

School of Public Health, University of Minnesota, Minneapolis, Minnesota

The Twin City metropolitan area is a center for grain merchandising, milling and processing. Certain particulate and gaseous contaminants are emitted from the different operations and processes of the grain industry.

University of Minnesota campuses are located in the vicinity of many grain industry plants. Approximately one half of the University student body reside within 2 miles of the main campus and receive a potential 24 hour exposure of grain pollutants. "Outbreaks" of asthma have occurred during periods of stable smoggy weather. Incidence of asthma among the student body has been a point of concern of the University Health Service.

Review of 288 medical records of asthma patients of the past few years gave evidence linking grain pollutants to individual asthmatic attacks. A higher percentage of asthmatics demonstrated sensitivity to grain mill dust upon skin testing than non-asthmatics. Insufficient data were available on the old records for correlation with certain weather parameters.

Detailed information on each asthma attack is now being obtained by an allergist. All asthma patients are keeping asthma "diarys" and, in the past 5 months, 167 asthma "calendars" have been given to first year students with history of asthma. Preliminary correlation of asthma attack data with weather information collected at a station on the main campus has been made.

Major emphasis of the environmental studies has been concerned with proteins in particulate samples. Total nitrogen and amino acid determinations have been made and a protein separation method with application to relatively small amounts of airborne particulates is being developed. Samples are collected at three permanent area locations and near certain operations in grain plants. Routine sampling of sulfur dioxide and periodic sampling of oxides of nitrogen and total oxidant is in progress.

NITROGEN DIOXIDE POISONING IN SILO ATMOSPHERES (SILO FILLERS' DISEASE)

LEONARD M. SCHUMAN

School of Public Health, University of Minnesota, Minneapolis, Minnesota

Human poisoning by oxides of nitrogen in silo atmospheres initially recognized and described by Lowry and Schuman in September, 1955, constitutes a distinct agricultural occupational hazard in a microclimate. Although initial cases included clinical and patholic diagnoses of bronchiolitis fibrosa obliterans with and without fatality, massive pulmonary edema and severe grades of pneumonitis, a spectrum of pulmonary disease is postulated to include lower grades of pulmonary involvement such as pulmonary fibrosis with or without emphysema, incipient cor pulmonale and chronic bronchitis as resultants by single and repeated lower dose exposures. The prevalence of such entities specifically related to oxides of nitrogen, outside of the occasional but highly dramatic acute and subacute episodes of poisoning, is recognizably difficult to establish in a population because of the existence of diverse etiologies and their production of virtually identical clinical and pathologic entities.

The methodology of approach to this problem is presented and includes: (1) Random sample surveys of farm populations in counties selected on the basis of low, moderate and high NO_2 production in silos to test the hypothesis that an excess of chronic pulmonary disease might be found among farmers with moderately to highly frequent potential exposures to silo gases as compared to those with few or no exposures; (2) Reviews of autopsy protocols (44,000) and hospital admission records (250,000) for pulmonary fibrosis, emphysema and cor pulmonale with retrospective epidemiologic investigation of farm cases for silo gas exposure; and (3) Epidemiologic follow-up of all suspect cases of silo fillers' disease.

The multidiscipline approach to the overall problem of human poisoning by silage gases is also presented and includes: (1) Pathogenesis studies on the incidence of pulmonary lesions in mice exposed to LD_{50} doses of gas; (2) The pulmonary lesions in mice repeatedly exposed to sublethal doses of NO_2; (3) The effect of components of silage gas other than NO_2 as possible adjuvants or synergists; and (4) Investigation of an allergic hypothesis to account for the lag or latent interval in human cases between exposure and the full-blown development of bronchiolitis fibrosa obliterans.

For the study of the numerous factors involved in the production of the agent (oxides of nitrogen) in its reservoir (the silo), field and laboratory silo studies of gas production in relation to type of crop, crop maturity, moisture, light in the growth period, type of soil, nitrogen, phosphorous and potassium content of the soil, fertilization practices, use of additives and preservatives and nitrate content of the ensiled crops, have been undertaken.

THE EFFECT OF ATMOSPHERIC FLUORIDES ON MAN

RICHARD A. CALL

Utah Valley Hospital of the Church of Jesus Christ of Latter-Day Saints, Provo, Utah

The presence of high concentrations of fluorides in the atmosphere has been associated with changes in plant and animal tissues in certain areas in Utah. It thus became important to determine if adverse effects were being produced in man. Of the ninety-five human cases studied to date for gross, histological and chemical evidence of fluoride intoxication, seventy came from geographic areas known to have had elevated fluoride levels in the atmosphere and forage. Analyses for fluoride, calcium, phosphorus and ash were made on the calvarium, sternum, rib, iliac crest and lumbar vertebra. Determinations for fluoride and dry matter were made on the following soft tissues: brain, heart, lungs, thyroid, aorta, liver, spleen, pancreas and kidney.

The highest fluoride bone levels were observed in cases showing the end stage kidney of bilateral pyelonephritis and polycystic disease, while average levels were found in cases of unilateral pyelonephritis and in cases of pyelonephritis with only slight to moderate disease. Due to the limited number of cases of chronic renal disease in this series, further studies are planned.

In addition, air sampling stations have been operated at the Utah State University in Logan, Hill Air Force Base near Ogden, Salt Lake Municipal Airport, Utah State Hospital in Provo. Meteorological data have been collected at these sites. Each station was equipped with a large Greenburg-Smith impinger and a Staplex-type high volume sampler.

The studies, to date, indicate that the levels of fluorides which Utah residents are being exposed to are not responsible for gross or histological changes in soft tissue and bone.

HEALTH EFFECTS OF AIR POLLUTION ON ELDERLY MALES IN LOS ANGELES

C. E. SCHOETTLIN

This monograph presents the purpose, methods and results of a two-fold epidemiologic study. In general the aims of the project were:

1. To assess the role of residential city size and climate, occupation, and smoking on the development of chronic respiratory disease in humans.

2. To determine the effect of daily changes in physical environment on the status of persons who have chronic respiratory disease.

A population of elderly males having a high prevalence of chronic respiratory disease was selected for the study. Each member of this population completed a questionnaire listing his life-time residential and smoking experience as well as duration of selected occupations. He was examined by a physician to determine presence or absence of selected symptoms and signs, and response to a pulmonary function test.

A sample of this population who met arbitrary criteria of "chronic respiratory disease" and matched controls were followed weekly in a project clinic. Clinic observations of symptoms and signs as well as pulmonary function tests, were used to determine changes in status of clinical disease in the individuals examined. In addition, several environmental measures were obtained for use with each clinic visit. These included temperature, relative humidity, chemical measures of air pollution, plant damage caused by air pollution, and observations of weather and haze.

One-hundred nineteen of the men examined during the initial screening died and were autopsied within one year after examination. Autopsy findings, clinical diagnoses and screening findings were compared as a check of validity of techniques.

UNUSUAL CORROSION PROBLEMS DUE TO ATMOSPHERIC EFFECTS

HERBERT C. McKEE

Southwest Research Institute, San Antonio, Texas

One of the undesirable manifestations of air pollution is the corrosion of metals and other materials. In many cases an understanding of corrosion effects requires detailed studies of atmospheric chemistry and of reactions at an air-solid interface. These problems are important to military agencies as well as to civilians.

To aid in understanding some of the unusual corrosion and deterioration problems which arise, Southwest Research Institute has been studying various problems under the sponsorship of the Office of Ordnance Research of the U. S. Army Ordnance Corps. Various weapons systems have been examined and samples of corroded material have been analyzed to determine the reaction mechanisms responsible for the deterioration.

The most important component of the atmosphere which affects corrosion is of course humidity. However, man-made pollutants frequently alter or accelerate the undesirable effects of natural humidity. In some cases, airborne pollutants arise from the system itself; in other cases, pollutants from the surrounding community may create serious problems even though their presence may not be suspected by the military agencies responsible for maintenance and repair.

Two of the special problems are described and illustrated, to show how complex atmospheric phenomena may influence the corrosion or other deterioration which occurs.

INERTIAL IMPACTION IN CYCLONE SEPARATORS

H. BINARK

The Pennsylvania State University, University Park, Pennsylvania

An experimental and theoretical study of inertial impaction in cyclone separators is reported. At the Pennsylvania State University a special wind tunnel was constructed for the study of inertial mist collectors. In this apparatus impaction efficiencies are being determined by sampling the mist before and after the collector under test. The total sample is divided into size fractions by rectangular jet stages. The author's theoretical analysis is based on the assumption of complete mixing of droplets. Other investigators calculate the impaction efficiencies as a function of tangential velocity taking it as a function of radius. This approach gives impaction efficiencies quite different from the experimental data obtained by fractional impaction. Calculations however based on complete mixing gave better agreement. For that purpose the tangential velocity in the cyclone is measured with a hot wire anemometer. The agreement between theory and experiment is then quite satisfactory. The number of turns of the gas stream in the cyclone seems to be very important for the impaction efficiency.

BASIC STUDY OF AIR POLLUTION CONTROL WET SCRUBBERS

SEYMOUR CALVERT

Case Institute of Technology, Cleveland, Ohio

Air pollution control problems are generally such that useful wet scrubbers must be efficient and cheap, offer low resistance to gas flow, and be "immune" to dust plugging. Consideration of these and other requirements provokes interest in several scrubbing mechanisms which offer promise of being especially effective in this service. The study at Case has focused on the fundamental mechanisms of collection (both gas absorption and particulate collection) by oscillating bodies of liquid attached to solid supports, by conduits with strong secondary flow patterns, and by froth.

The research, which is composed of 6 graduate theses in Chemical Engineering, is at various stages of progress. Specific information given in this paper will be mainly on collection of particles in baffled flow channels with brief summaries of the status of other topics.

FLUE-FED INCINERATORS FOR APARTMENT BUILDINGS

E. R. KAISER

Research Division, New York University College of Engineering, New York, New York

Tests previously reported by New York University have shown how air pollution from flue-fed incinerators can be reduced by appliances, including hopper locks on the flue, overfire air jets in the furnace, auxiliary gas firing, and especially by flue-gas scrubbers. The devices are now being offered commercially for installation in existing incinerators.

Further investigation is being made to prove better designs of new installations and to evaluate other methods of pollution control. Experimentation is not now under way but the problems are being studied by field observations.

The conventional practice of building the flue from a rear corner of the furnace seriously limits furnace capacity and causes added entrainment of dust and paper with the gases as they leave the furnace. A more central location of the flue, particularly from a pyramidal furnace roof, should be tested.

The use of large chambers on the roof to settle out dust and charred paper from the flue gas, while partially effective, has a serious drawback. The resistance to gas flow is high enough to cause positive pressures in the flue at the upper floor levels. The resultant leakage of gases through the hopper seals causes odors and soiling in the hallways of the upper floors.

As the entrainment of particulate matter in the flue gases can be markedly reduced by control of the upward gas velocities during burning, the use of barometric air and orifice dampers in the flue is being evaluated. Multiple-chamber incinerators, double flues, and other design modifications are also being considered.

AIR AND GAS FILTERS FOR HIGH-TEMPERATURE APPLICATIONS

WALTER J. SMITH

Arthur D. Little, Inc., Cambridge, Massachusetts

The practical use of treated glass-fiber fabric bag filters for high-temperature dust removal now has a history of two years or more. The remarkable success achieved by the pioneer installations has excited renewed and greater interest in this simple but effective means of air pollution control in the cleaning of hot effluent gases.

The key to successful operation of glass bag filters is in proper fabric design and fiber lubrication; correct mounting; minimum mechanical working of the bag in use; and adequate attention in service maintenance. In some installations bag life has ceased to be a problem. Achievement of satisfactory service life becomes more difficult with increase of temperature. Current experience in cement plants indicates indefinitely long bag life at 450°F and several years' service at 600°F.

The U. S. Public Health Service has sponsored basic investigative work on improvement of high-temperature bag filter performance. Rapid evaluation techniques were developed for use in this study. Conclusions are that bag life and performance can be greatly influenced by the kind of fiber lubricant used and the effectiveness of application.

EVALUATION OF AIR CLEANERS FOR OCCUPIED SPACES

K. T. WHITBY AND R. C. JORDAN

University of Minnesota Institute of Technology, Minneapolis, Minnesota

Current research on air cleaners for occupied spaces by the University of Minnesota Particle Laboratory under USPHS Grant S-23 may be divided into two areas.

1. Evaluation of the performance of 17 representative types of air cleaner covering the performance range from roughing to absolute by the following techniques:

   a. Stain efficiency, weight efficiency, and loading characteristics using the previously developed coal dust-lint mixture simulating natural airborne dust.

   b. Correlation of performance with improved parameters for the description of filter mats. The parameters which include an effective fiber size and a filter solidarity factor can be determined for any filter mat from simple air flow measurements.

   c. Measurement of fractional efficiency curves over the particle size range from 0.1 to 15 μ using newly developed "model T" homogeneous aerosol generators.

   d. Measurement of efficiency of removal of natural airborne microorganisms.

2. Since aerosol generators are so vital to good research in the aerosol removal field, work to develop some simple reliable aerosol generators is in progress. This includes the following:

   a. Development of a spinning disk aerosol generator for solid particles. Satisfactory homogeneous aerosols of methylene blue from 0.6 to 15 μ can now be generated reliably.

   b. A specially designed impactor in combination with a Collison atomizer is being developed to generate reasonably homogeneous aerosols in the 0.1 to 1 μ range.

   c. The low aerosol output of the above generators has been circumvented by a membrane filter "development" technique and in situ photometric measurement. This permits rapid and accurate evolution of low methylene blue aerosol concentrations.

   d. Artificially generated aerosols such as the coal dust and methylene blue have been found to be electrically charged to a troublesome degree. A method of discharging aerosols particles by mixing with a high concentration of gas ions generated by a unique electrical ionizer has been developed.

DIFFUSION OF VENTED GASES AROUND BUILDINGS

JAMES HALITSKY

New York University College of Engineering, University Heights, New York, New York

Many industrial buildings discharge combustion, laboratory and process gases through short stacks or flush openings in side walls and roofs. The gases are eventually borne away by the wind, but not until they have circulated about the building, polluting the air in the neighborhood of ventilation intake ducts and open windows.

Wind tunnel studies of simple geometrical building shapes in a steady wind were made in which gas was discharged from ports in the roof and walls. Air samples at short distances from the surfaces were analyzed. Distribution patterns were delineated. It was determined that with no buoyancy in the exhaust the most important factor affecting the general level of contamination at points on the building distant from the exhaust opening is the turbulent wake of the building. Gas will diffuse throughout the wake, and sometimes will be found at upwind locations on the building even if the exhaust is on the lee side. Semi-empirical formulae were derived for predicting these concentrations. Close to the exhaust opening, the concentrations are very sensitive to wind direction, ejection speed, stack height and obstructions. Highest surface concentrations near the exhaust opening usually occur in a direction other than that of the mean wind. Moving outward, concentrations increase to a maximum several times greater than at the surface and then decrease to zero at the wake edge.

UPTAKE OF FLUORIDES BY GRASS GROWN ON FLORIDA SOILS

R. C. SPECHT

The American Agricultural Chemical Company, Pierce, Florida

Lysimeter tests were made on a composite sample of the top 6 inches of a Leon fine sand soil obtained from an 800 acre plot purported to be in a fluoride polluted area. Leaching of the soil with distilled water and with water containing fluorides, equivalent to 30 inches rainfall, demonstrated an inherent ability of the soil to fix the fluoride ion from fluoric acids and from calcium fluoride as direct additions and as a component of superphosphates.

Pensacola Bahio grass was grown in a New Jersey greenhouse on the soil used in 9 separate treatments of the lysimeter tests. Analysis of the harvested grass indicates there is no significant difference in the fluoride content of the grass grown on the soil, whether the soil was leached with distilled water or with water containing fluorides.

SAMPLING AND IDENTIFICATION OF KRAFT PULP MILL GASEOUS EFFLUENTS

D. F. ADAMS

Division of Industrial Research, Washington State University, Pullman, Washington

A new technique has been developed for source sampling and analysis of malodorous gases from the kraft pulping process. The pollutants are adsorbed and/or condensed on activated silica gel at -78.5°C.; transferred to a gas chromatograph for desorption and preliminary separation, and the malodors trapped and analyzed by re-chromatographing on a gas-liquid chromatographic column.

Water, being more polar than the malodors, must be preferentially removed from the source sample prior to adsorption to prevent chromatographic elution of less polar compounds. The major portion of the water is eliminated by condensation at 0° C. and additional water vapor is removed on a solid desiccant such as anhydrous potassium carbonate or calcium sulfate.

Retention of both more volatile and less polar malodors on the activated silica gel is achieved by a combination of adsorption and condensation processes at the dry ice-acetone temperature. The adsorbed sample is then desorbed from the silica gel by placing the sampling column in a gas chromatograph and sweeping the column with helium while elevating the column temperature from -78.5°C to 100°C. A rough chromatogram is obtained during this desorption. Some carbon dioxide is condensed on the silica gel column during the sampling of certain source gases and emerges first as the column temperature rises from -78.5°C. to room temperature. The CO_2 is vented to waste. A liquid nitrogen-cooled trap is attached to the chromatograph exhaust stream as soon as the elution of CO_2 is shown to be complete. The entire trapped sample is then introduced onto a gas-liquid chromatographic column and analyzed in the conventional manner using the rising column temperature technique.

VARIATION OF DIFFERENT POLLUTANTS IN THE ATMOSPHERE OF MEXICO CITY

H. A. BRAVO

Industrial Hygiene Laboratory, Department of Health, Mexico

Two distinctive air pollution sampling stations are being used to obtain the data reported in this paper. One station is located in the N.N.W. area (Tacube), which borders one of the heavier industrial zones. The other station is located in the S.W. area which is a residential zone (University City).

From the collected data, it is easy to show the great influence that the N.N.W. industrial area, considering the city's topographical situation and general local meteorological factors, has in the air contamination problems in Mexico City.

The concentrations of solid material suspended in the air and gaseous pollutants, show two maximum peaks, one in the first hours of the morning and the other in the late afternoon hours.

The SO_2 values found in Mexico City are relatively high; and the values for oxidants are low, even in comparison, with non contaminated areas. The organic neutral fraction, obtained from the crude material extracted with benzene from the material suspended in the air, has a high content in aromatic material (52%).

The obtained levels of contamination which are shown in this survey, give a good indication that it is necessary to initiate an air pollution control program in Mexico City.

RESULTS FROM A CONTINUOUS MONITORING PROGRAM

J. CHOLAK

Department of Preventive Medicine and Industrial Health, College of Medicine,
University of Cincinnati, Cincinnati, Ohio

The program of air monitoring conducted by the Laboratory since 1938 will be described. The air pollutants investigated and the reasons for interest in their presence in the air will be discussed. Methods for the continuous collection of certain pollutants will be described briefly. A resume of findings, as related to the concentrations of particulate matter, oxidants, nitrogen dioxide, nitric oxide, sulfur dioxide in Cincinnati air will also be given. Future programs of investigation will also be described.

A STUDY OF THE RELATIONSHIP OF STREET LEVEL CARBON MONOXIDE CONCENTRATIONS TO TRAFFIC ACCIDENTS

GEORGE D. CLAYTON

George D. Clayton and Associates, Detroit, Michigan

In Germany and the Scandinavian countries investigators have published extensive observations concerning carbon monoxide exposures insufficient to cause subjective symptoms but which, they report, have affected the cardiovascular, endocrine and respiratory systems, the blood and the central nervous system, causing in the latter disturbances of vision, hearing, speech, and the reflexes. Since a disturbance of vision and reflexes could be factors influencing traffic accidents, a research project was begun in 1956 to determine whether carbon monoxide as an atmospheric pollutant may have a sufficient effect on the individual driver in urban areas to exert a causal influence on automobile accidents.

To determine the CO in the atmosphere, three recording infrared CO analyzers were set up at various locations in Detroit. The instrument's full scale reading was 100 ppm, with reliable readings as low as 1 ppm. For a period of 27 weeks a recorder was located on a depressed highway within the city. The data obtained from this station showed CO readings ranging from 0-100 ppm with a median of approximately 8 ppm. Another recorder was placed in a busy neighborhood shopping area for 58 weeks. The CO readings at this location ranged from 0-100 ppm with an approximate median of 10 ppm. For 21 weeks a recorder was operating in downtown Detroit, and here again, the CO readings ranged from 0-100 ppm, with a median of approximately 9 ppm. The CO in the atmosphere of a residential area was sampled for a period of 18 weeks. These concentrations ranged from 0-29 ppm with a median of only 2 ppm. The data obtained from these infrared analyzers was tabulated first by quarter hour and then by hourly intervals. These data were then correlated with such other factors as traffic count and meteorological conditions, which were also recorded on an hourly basis. From these data we are attempting to predict under what conditions dangerous concentrations of carbon monoxide can be created in the atmosphere.

Another phase of the study included the taking of blood samples from drivers and pedestrians involved in automobile accidents to determine the percent of CO saturation. A total of 227 blood samples have been analyzed and the results ranged from less than 0.5 to 31.5 percent saturation with an approximate median of 1.7 percent saturation.

RELATIONSHIP BETWEEN AERIAL OBSERVATIONS AND GROUND ANALYSIS OF AIR POLLUTANTS

PHILIP W. WEST AND A. R. CHOPPIN

Coates Chemical Laboratories, Louisiana State University, Baton Rouge, Louisiana

WILLIAM R. COOPER

Kem-Tech Laboratories, Inc., Baton Rouge, Louisiana

Four years of experience have provided convincing evidence that there may be great value in the combined use of aerial observations and aerial photography, combined with chemical and physical studies of air pollution. Aerial photographs are particularly useful in correlating what can be seen with what is found by means of physical and chemical studies. Furthermore, aerial perspectives often prove convincing to plant personnel where analytical data fail to make a significant impression.

By means of ground to air communications, it is possible to effectively direct the sampling schedule so that the optimum sample points are selected. In addition, valuable information on temperature lapse rates can be obtained by following temperature gradients during takeoffs and landings.

THE EFFECTS OF SIMULATED OXIDANT TYPE POLLUTANTS ON MICROORGANISMS

JOSEPH H. GAST

Resources Research, Inc., San Mateo, California

A dynamic method, for studying the effects of gaseous chemical agents on microorganisms, has been worked out using the muliplication of E.coli in a glucose salt medium after their exposure on and removal from, a millipore filter. Testing and proving of the method using pure gases will be discussed.

Application of the millipore filter technique for assessing the effects of exposure to an irradiated oxidant type synthetic pollutant mixture demonstrates a marked and consistent inhibition of growth. A natural extension of this procedure is to determine what chemical agents could effect a reversal of the inhibition of the growth lag. A study of several mixtures has indicated that either yeast extract or a mixture of amino acids when added to the growth medium, in which the inhibited organisms are suspended, will bring about such a reversal. The significance of these results will be discussed.

The demonstration of decrease in the rate of multiplication of intact E.coli following exposure to the synthetic air pollutants indicated the desirability of studying their effects on enzyme systems.

The aldolase activity of cell-free extracts of E.coli has been studied following exposure to the pollutant mixtures. The results to date indicate (1) complete inhibition of aldolase activity after 30 minute exposures to both the irradiated and un-irradiated pollutant mixtures, (2) rate of inhibition is more rapid in the first 15 minutes of exposure to the irradiated mixture.

Study of the effects of pH, ionic strength, temperature indicate it to be a true enzyme denaturation. Present studies are in progress to ascertain the effect of nitro paraffins on the enzyme activity and the effect of certain metal ions on the enzyme activity.

ALIPHATIC NITRO COMPOUNDS AND THEIR IN VITRO BIOCHEMICAL EFFECTS ON ENZYME SYSTEMS

FRANCES L. ESTES

Baylor University College of Medicine, Houston, Texas

Aliphatic nitro compounds are implicated as air pollutants. These compounds are potential contributors to the 302 mμ absorption shown by the synthetic oxidant type pollutant mixture when collected in a basic solution. At low concentrations they inhibit the oxygen consumption of whole leucocytes as well as homogenates of heart and of liver. As the concentration of the nitro compound is increased the inhibition passes through a maximum.

In the presence of these compounds neither the succinoxidase nor the cytochrome oxidase system shows the expected linearity of response to tissue concentration. This effect is not related to reactions of the nitro compound with components of the system in the absence of tissue, but appear to depend on the tissue-nitro compound ratio.

The conclusion that more than one reaction is involved is further indicated by the observation that nitro compounds will undergo reduction as well as oxidation in the presence of homogenates of heart tissue. Likewise, the disappearance of inorganic phosphate is increased over that of the control. There is however no simple relationship between the oxygen consumption and the phosphate disappearance.

Of the possible products which may be formed from the nitro compounds, nitrite ion formation has been found to be non-enzymatic and to account for less than 10% of the nitro compounds added. Because of their chemical nature further exploration of these compounds may provide a means for clarifying the effects of oxidant type pollutants.

THE SUBACUTE TOXICITY OF SEVERAL NITRO-OLEFINS

WM. B. DEICHMANN AND W. E. MacDONALD

Department of Pharmacology, University of Miami School of Medicine, Miami, Florida

The subacute inhalation toxicity of 2-nitro-2-butene, 3-nitro-3-hexene and 4-nitro-4-nonene has been investigated in the rat, rabbit, mouse, and guinea pig. The animals were exposed to vapor concentrations of approximately 20 ppm for six hours per day on five days of the week for two to five weeks.

The signs of intoxication were essentially the same for each of the compounds. All species suffered intense eye and respiratory irritation as evidenced by coughing, sneezing, and pawing of the eyes and nose. The guinea pig and rabbit exhibited marked salivation and lachrymation. As the expirement progressed, the animals showed signs of increasing dyspnea.

Based on mortality data, the rat was the most susceptible species, the rabbit was less susceptible, while the guinea pig and mouse were affected the least.

Gross pathological examination revealed generally the same changes for each of the three compounds, namely hyperemia and edema of the pharynx and trachea, and hyperemia and congestion of the bronchi and parenchyma of the lung. The butene and the nonene were somewhat more toxic than the hexene.

EFFECTS OF OZONE, SULFUR DIOXIDE, AND NITROGEN DIOXIDE UPON TISSUE CELLS *IN VITRO*

DONALD M. PACE AND JAMES R. THOMPSON

Department of Phsiology, University of Nebraska, Lincoln, Nebraska

A description will be given of the methods developed in this laboratory which permit the exposure of replicate cell cultures to specific concentrations of known air pollutants for selected time intervals. Consideration of the problems encountered in such a system as well as results of studies employing low concentrations of ozone, nitrogen dioxide, and sulfur dioxide will be discussed. The effects of both intermittent and continuous exposure to these pollutants upon the growth rate of cells *in vitro* will be considered.

AIR POLLUTANT EFFECTS IN MICE

R. D. BOCHE

The College of Medical Evangelists, Los Angeles County Hospital, California

Mice show variations in spontaneous wheel-turning activity which are, in part, determined by age, sex, genetic constitution, hormones, drugs, nutritional status, and other factors. They are responsive to synthetic smog which inhibits their activity, and it has been shown that increased amounts of smog cause greater inhibition. While the response is non-specific for different pollutants, the ozone and hydrocarbon components of ozonized gasoline mixture have a quantitatively different effect. The technique demonstrates a sensitive method for studying the effects of brief exposure to air pollutants in the intact animal.

SYNERGISM OF AEROSOLS

ALEXANDER GOETZ

California Institute of Technology, Pasadena, California

Synergism of aerosols may be defined as the modification of the physiological effect of toxic (or irritant) gaseous traces (T) in the atmosphere by coexisting submicron particulates (P), due to mutual chemical or physical interaction. This modification can result either in an intensification or an attenuation, depending upon the type of interaction between (T) and (P):

If a less toxic (or insoluble) compound results, or (T) attaches itself irreversibly (by sorption, capillary condensation, etc.) to (P), an attenuation is to be expected and has been demonstrated. It is only evident for high concentrations (C_P) of (P), and low (C_T).

From the viewpoint of air pollution, the intensifying synergism is much more important. Its mechanism is obvious in the rather rare cases, when a more toxic compound results from the interaction, such as the catalytic oxydation of ($SO_2 \rightarrow SO_3$) in the presence of Mn-bearing aerosols. Apparently more general is the intensifying effect of (P) if its substance has a sorptive affinity for (T) which is large enough to produce an accumulation on the (P)-surface, but smaller than the affinity of the tissue surface which (P) contacts so as to effect a transfer of the (T) thereon. The association of (T) with the particles will in most cases not eliminate all free (T) molecules; instead a dynamic equilibrium will exist between associated and free (T), this ratio to be the larger the smaller the (C_T). (P) will contribute less to the irritation for larger (C_T) because of the increasing contact by the free (T). Hence this type of synergism will: a.) be restricted to relatively small values of (C_T); b.) increased for fixed (C_T) with (C_P); c.) will decrease for fixed (C_T) and (C_P) with the increasing particle size.

A theoretical approach based on the kinetic aspects of free gas molecules and their interaction with the surface of air-borne particles is presented. The theoretical functions derived from these assumptions are applied qualitatively to the data reported by LaBelle et.al. for 27 gas-aerosol combinations, and quantitatively to those by Amdur on the effect of NaCl aerosols in the presence of HCHO. Within the margin of experimental error the data can be described quite accurately by the theoretical functions and no conflict is apparent.

SURVIVAL OF RATS CHRONICALLY EXPOSED TO SULFUR DIOXIDE

R. M. HEYSSEL, O. J. BALCHUM, Z. A. COLES, JR., C. O. T. BALL AND G. R. MENEELY

The Departments of Medicine and Preventive Medicine and Public Health,
Vanderbilt University School of Medicine, Nashville, Tennessee

Male Sprague-Dawley rats are maintained in constant temperature humidity controlled exposure chambers chronically breathing 0, 1, 2, 4, 8, 16 and 32 ppm SO_2. The rats are transferred daily to clean, serviced cage racks, are carefully examined and weighed weekly with hematologic studies quarterly and pathologic studies at death. Incidence and degree of wheezing, eye opacities, loss of fur and scaley tails are associated with sulfur dioxide concentrations. The control group maintains the best weight. White blood cell counts, per cent neutrophils and hemoglobin are elevated in the SO_2 exposed groups. Per cent survival was significantly lower in 32 ppm rats after 4 months exposure. After 8 months, all of the control group, 92% of the 1-16 ppm groups and 75% of the 32 ppm groups were alive. At 12 and 13 months the corresponding per cent survivals are 91, 86 control; 83, 79 1-16 ppm SO_2 and 49, 41 32 ppm SO_2.

PHENOLIC COMPOUNDS IN URBAN AIR AND THEIR BIOLOGICAL ACTIVITY

RALPH G. SMITH

Wayne State University, College of Medicine, Detroit, Michigan

An air sampling program which has been conducted in Detroit for several years has shown that minute quantities of phenolic compounds are present in normally polluted city air. These compounds are largely present as vapors, but lesser quantities are also in the organic fraction of the particulates. Chromatographic resolution followed by ultraviolet absorption spectrophotometry has shown that the simpler phenols are present, as well as unresolved complexes of higher molecular weight compounds. Specifically, phenol, the cresols, and o-hydroxy-benzaldehyde are consistently found in all samples, and these same compounds are found in numerous samples of automotive exhaust products.

The toxicology of these compounds in relatively high concentrations is well known, and our vapor phase studies at such concentrations (about 100 PPM) did not reveal any unexpected findings. Data which will be of significance, however, is expected to result from long-term studies in which particulate matter collected from the atmosphere has been modified and introduced into experimental animals intratracheally. The following injections have been made: "pure" particulate matter, unchanged; inorganic particulates; organic matter adsorbed onto alumina; phenolic fraction adsorbed onto alumina, and others.

These studies are in progress, and partial findings will be discussed.

AUTO EXHAUST CONTROL

W. L. FAITH

Air Pollution Foundation, San Marino, California

Proposals to control automobile and other motor vehicle exhaust emissions stem from the attributes of three exhaust constituents:

1. Olefinic hydrocarbons (react with nitrogen dioxide in sunlight to produce photochemical smog).

2. Carbon monoxide (toxic gas).

3. Polynuclear hydrocarbons (suspected carcinogens).

One can always hope that improvements in internal-combustion engines will eventually eliminate these emissions, but until that day comes, the most promising method of alleviation is "afterburning" the undesirable combustibles in exhaust.

The nature of motor vehicle exhaust is such that both air and energy must be added part of the time to accomplish sufficient burning; at other times no additional air is needed, and energy must be removed. Three methods of adding energy show promise:

1. Use of a heat exchanger in a direct-flame afterburner.

2. Use of auxiliary fuel in a direct-flame afterburner.

3. Use of an oxidation catalyst.

Chief problems facing developers of devices are economic, e.g., size, material of construction, method of adding air, maintenance and replacement requirements, ease of inspection, installation cost, cost of certification, size of market, legal requirements.

MOST RECENT DEVELOPMENTS IN AUTOMOTIVE INDUSTRY PROGRAM

W. F. SHERMAN

Automobile Manufacturers Association, Detroit, Michigan

LEGALITY AND LEGISLATION REGARDING CONTROL OF POLLUTANTS FROM MOTOR VEHICLES

HAROLD W. KENNEDY

The County Counsel of Los Angeles County, Los Angeles, California

AUTO EXHAUST CATALYSTS

W. E. SCOTT

William E. Scott & Associates, Dublin, Pennsylvania

Nitrogen oxides play a vital role in the photochemically induced, smog producing reactions occurring in the atmosphere. The primary source of these oxides is combustion processes. In some areas, like Los Angeles, a high percentage of these oxides is produced by automobiles. One possible way to alleviate the smog is to remove nitric oxide from auto exhaust. Preliminary evaluation of catalysts for the reduction of nitric oxide by the CO and/or H_2 components of exhaust has been carried out with promising results. Zinc-copper chromite, iron chromite, barium promoted copper chromite and chromium promoted iron oxides were found to be very efficient for removing NO in the presence of CO at temperatures of 220-320°C. Chromites would also induce oxidation of hydrocarbons and CO when sufficient O_2 is present.* Experiments are now in progress continuing the evaluation of these catalysts with actual exhaust from a car operated under cruising conditions on a chassis dynamometer. The effect of lead from leaded fuels on the catalysts is also being studied. Infrared and gas chromatographic techniques are employed for analysis of the exhaust gases. Early results from the experiments will be presented.

* Report No. 28, Air Pollution Foundation, San Marino, California

NONCATALYTIC AFTERBURNING IN DIFFUSION FLAMES OF AUTOMOTIVE EXHAUST

J. GRUMER

Explosives Research Laboratory, Bureau of Mines, U. S. Department of the Interior

Information is being sought by the Bureau of Mines on which to base concepts that can be used in designing a noncatalytic afterburner of automotive exhaust. However, the actual design of such an afterburner is not an objective of the Bureau's investigation. One concept under test is that ducted diffusion flames or rich premixed semi-diffusion flames of typical exhaust mixtures have wider flame-stability limits than premixed stoichiometric or fuel-lean flames. This concept is based on the possibility of exploiting the temperature of the exhaust as it leaves an engine. A flame of hot exhaust should be easier to stabilize than a cooler mixture of hot exhaust and cold air used in premixing. As much air is needed for complete burning in a dissuion flame as in a premixed flame - but because the mixing with cold air proceeds in a diffusion flame, heat is released by the combustion. This is not so in premixed flames of exhaust and cold air -- the cooling precedes inflammation.

To date, only exploratory experiments have been done with a simulated idling exhaust. Ducted diffusion flames of this exhaust were more stable than rich semi-diffusion and slightly lean premixed flames. These results support the analysis that complete premixing of exhaust and air before burning is undesirable. Tests of completeness of burning of the simulated idling exhaust are being made.

METAL OXIDE CATALYSTS FOR OXIDATION OF AUTOMOTIVE EXHAUST

K. C. STEIN, J. FEENAN, L. J. E. HOFER, AND R. B. ANDERSON

Bureau of Mines, U. S. Department of the Interior, Pittsburgh, Pa.

In the Bureau of Mines-Public Health Service program on catalytic oxidation of automotive exhaust, emphasis has been placed on metal oxide catalysts. Many pure metal oxides of moderate to high surface area were tested with 4 or more different C_5 and C_6 hydrocarbons in a microcatalytic reactor. The better oxides, listed in order of decreasing activity, were: cobalt, nickel, manganese, chromium, cerium, titanium and ferric oxides. The following order of increasing difficulty of oxidizing hydrocarbon types was observed: acetylene, olefin, normal paraffin, branched paraffin, alicyclic and aromatic. A variety of impregnated and supported catalysts are being screened. For oxides impregnated on robust alumina pellets, the following order of decreasing activity was obtained for the better catalysts of the group: chromium, manganese, vanadium, iron, uranium, copper and cobalt.

More detailed information on the rates was obtained in a flowing system using concentrations of hydrocarbons and oxygen found in automotive exhaust. In these tests, for example, chromium oxide on alumina removed more than 85% of pentene-2 at hourly space velocities up to 20,000 reciprocal hours and at 400°C. and above.

Engine tests have been made to select robust catalyst supports and to examine the deposits from gasoline containing tetraethyl lead and other additives. Spherical pellets of γ-alumina meet most of the requirements for a catalyst support. Deposits of PbBrCl, $PbSO_4 \cdot PbO$, and $PbSO_4$ were obtained from leaded gasoline at 400° to 600°C.

AUTOMOTIVE EXHAUST STUDIES IN THE UNITED KINGDOM

P. J. AWTHER

Medical Research Council, Dunn Laboratories, St. Bartholomew's Hospital, London, England

Pollution of the air by carbon monoxide, oxides of nitrogen, smoke, polycyclic hydrocarbons and lead by motor vehicles are being studied in Britain by the Medical Research Council.

In the past much attention has been paid to the emissions from the exhausts of vehicles but in the work briefly reported here emphasis has been placed on the ambient air. Work on the pollution of garage air by diesel buses was followed by analyses of street air and finally, in a search for significantly polluted atmosphere, vehicular tunnels have been studied. Attempts have been made to attribute the various pollutants to their sources and the respective roles of diesel and petrol engines will be discussed.

POTENTIALS OF PULMONARY CYTOLOGY IN EVALUATING EFFECTS OF AIR POLLUTION

SEYMOUR M. FARBER

University of California Tuberculosis & Chest Service, San Francisco General Hospital

The normal current of the bronchial secretions acts as a constant, natural "currettage" carrying exfoliated cells from the bronchial lumen upward in the sputum. The microscopic examination of sputum and bronchoscopically obtained secretions has been utilized for the cytologic detection of the lung cancer and certain non-malignant pulmonary diseases. Until recently, these studies have required examination of multiple samples because of the heterogeneity of particles which are selected and smeared. We have recently developed a new method for concentrating the cellular elements of sputum which provides a homogeneous sediment; a sampling from which is representative of the entire specimen. In the course of developing this method, we have been impressed with the comprehensiveness of the microscopic picture. We are now able to accurately determine the relative numbers of the various cell types present in an entire sample, rather than the chance distribution of cells present in a selected area of the specimen.

We have been interested in employing sputum concentration to evaluate possible cytologic effects of air pollution upon human bronchial epithelium. Perhaps the most interesting preliminary observations might be obtained in a comparative study of the sputum from inhabitants of various localities and industries associated with air pollutants. Specific cellular changes observed in sputum and lungs of animals and men with various forms of pulmonary pathology will be reviewed in the presentation.

THE RELATION OF ENVIRONMENTAL FACTORS TO PATHOLOGIC CHANGES IN THE HUMAN TRACHEA AND BRONCHI

KENNETH P. KNUDTSON

Veterans Administration Hospital, Seattle, Washington

One hundred and fifty lungs removed at autopsy were examined by the Swiss Roll method. Changes in the bronchial mucous membrane are correlated with the patient's age, occupation, site of residence and smoking history. Location of foci of metaplasia in the bronchial tree and quantitation of the changes are evaluated. The sequence of changes in the bronchial mucosa leading to bronchogenic carcinoma are considered first, basal cell hyperplasia with reduction in mucous secretion. This is followed by metaplasia of the basal elements to squamous epithelial cells with maturation of those cells to form keratinized epithelium. Ciliary action is thus lost and normal secretions are further suppressed. It is postulated that these cells are altered in such a way as to increase their affinity for lipid-soluble substances leading to preferential absorption of carcinogenic hydrocarbons. It is our impression that basal cell hyperplasia, squamous metaplasia and atypical change represent changes of increasing significance in that order and are in all probability consecutive stages in mucosal transformation to carcinoma of the lung.

FACTORS INFLUENCING THE CARCINOGENICITY OF INHALED RADIOACTIVE DUSTS

HERMAN CEMBER

Graduate School of Public Health, University of Pittsburgh, Pittsburgh, Pa.

The results of a series of experiments in which the carcinogenicity of radioactive particulates in the lung was investigated will be integrated and discussed. Some of the treatments in these experiments resulted in bronchogenic carcinoma, while other treatments failed to elicit a carcinogenic response. The experiments showed that absorbed dose to the lung is not by itself a reliable measure of carcinogenicity. The time during which a given radiological insult is administered seems to be an important factor in determining the probability that the insult will result in malignancy. The most potent pulmonary carcinogen used in these experiments was Ce^{144} - Pr^{144}. Preliminary data on carcinogenesis experiments currently in progress, in which soluble and insoluble compounds containing these isotopes were intratracheally injected into the lungs of rats, will be presented.

THE REPAIRATIVE CAPACITY OF ANIMAL LUNGS AFTER EXPOSURE TO VARIOUS SINGLE AND MULTIPLE DOSES OF NO_2

JEROME KLEINERMAN AND GEORGE W. WRIGHT

Department of Medical Research, Saint Luke's Hospital, Cleveland, Ohio
and The Saranac Laboratory of the Trudeau Foundation, Inc., Saranac Lake, N.Y.

Rats, rabbits and guinea pigs were exposed to controlled concentrations of Nitrogen Dioxide for two hour periods. In single dose experiments, animals were subjected to either a high dose (rabbits 200 ppm; rats 150 ppm), a moderate dose (rabbits 100 ppm; rats and guinea pigs 75-80 ppm), or a low dose (rabbits 25 ppm; rats and guinea pigs 15-20 ppm). Following this exposure, animals were sacrificed at 1, 2, 4, 7, 14, and 21 days; the lungs were fixed, prepared, and studied histologically. In multiple dose experiments animals were exposed on five successive days to low concentrations. Animals were sacrificed according to the above schedule. All rats and 33% of rabbits expired within twenty-four hours of the single high dose, with severe pulmonary edema. All animals survived the single moderate dose. At twenty-four hours in these groups a moderate degree of pulmonary edema is observed. Inflammatory exudate is most prominent in the region of the respiratory bronchioles and epithelial degeneration and regeneration are noted. By the fourth day, edema and acute inflammatory changes are replaced by macrophage infiltration and epithelial regeneration is extensive, localized mainly in the region of the respiratory bronchiole. Repair is complete by two weeks, only traces of chronic inflammatory exudate remain and these are usually perivascular, some epithelialization of alveolar spaces about respiratory bronchioles also persists.

In the multiple low dose exposures, edema and inflammation are less severe early, but peribronchial and perivascular chronic inflammation are more pronounced in the rat and guinea pigs. The number of respiratory units involved is less and epithelial regeneration is not prominent. Complete healing appeared to occur somewhat earlier after this type of exposure.

In summary, permanent alterations were not observed in the lungs of animals surviving exposure to NO_2 in the doses mentioned. Pulmonary edema is observed early and inflammatory and epithelial regeneration changes are most severe in the region of the respiratory bronchiole. Healing appears to be practically complete by two weeks after the insult.

AN EVALUATION OF METHODS FOR RECOGNIZING CHANGES IN AIRWAY RESISTANCE

THOMAS C. LLOYD, JR.

USPHS Department of Medical Research, Saint Luke's Hospital, Cleveland, Ohio

Measurements of Maximum Breathing Capacity, Maximum Expiratory Flow, Maximum Mid-expiratory Flow and Airway Resistance were made utilizing the body plethysmograph, Ainsworth-Clements interrupter, Wright peak flow meter, and a modified Wright-Gilford digital spirometer. Changes in resistance were produced by inhaling dust suspensions and these changes were reversed by inhaling a bronchodilator. Sets of data were obtained before and after dust and after the bronchodilator. The plethysmograph results were expressed as a volume-corrected resistance, the others by their direct read-out values or values obtained by standard calculation. If one assumes the dust to have increased the resistance and the bronchodilator to have reversed this change, then analysis of the data without regard to magnitude but simply to direction of change results in the following:

The plethysmograph indicated the assumed change in 100% of opportunities available; MBC in 95%; WPF in 87%; MMF in 71%; and Clements interrupter in 50%. In terms of magnitude, the plethysmograph changes were significant in 100%, MBC in 50%, and WPF in 65%. The Clements interrupter data never varied by an amount greater than the control variations and the MMF was significant in less than 20%. Regarding specific methods, the variations in Clements interrupter data could not be abolished by warming the valve or by measuring only at constant lung volumes; the falls in MBC were sometimes produced by the presence of cough; and the MMF was easily obscured by failure to achieve true vital capacity. While the peak flow data were extremely dependent on effort and starting volume it was usually possible to get three maximal values within 6%. These results in favor of the plethysmograph have led to minor modifications and use in the field.

DESORPTION PRODUCTS FROM ACTIVATED CARBON

AMOS TURK

Department of Chemistry, The City College, New York, New York

Desorption products from activated carbon are being studied from the following aspects:

1. Activated carbon in equilibrium with air is very retentive to gases of relatively high molecular weights. Such gases may be recovered, however, in forms suitable for analysis. The degree of recovery and the chemical fidelity of the recovered material are under study. Desorption methods include evacuation with cold trapping, solvent extraction, and displacement. Critical factors are bed depth, pressure, temperature, and nature of displacing gas.

2. Reagent-impregnated carbon may be used for chemisorption of light gases. Ethylene, for example, is efficiently removed from an air stream by brominated carbon. The course of such reactions for other olefins is under study. It has been found that cyclohexene undergoes trans-addition, just as it does in a liquid reacting medium.

3. Air streams which pass through a bed of activated carbon are characteristically, though mildly, odorous. The production and nature of the odor is being studied.

4. The recovery of organic gases from air is always complicated by admixture with water, and by the fact that solid desiccants may act as adsorbents for such gases. The use of non-adsorbing aqueous desiccant salt solutions for this application is being examined.

THE SYNTHESIS OF SOME ALKYL DIBENZYPYRENES

FRANK A. VINGIELLO

Department of Chemistry, Virginia Polytechnic Institute, Blacksburg, Virginia

It has long been established that polluted air often contains polynuclear aromatic hydrocarbons which are capable of inducing cancer. Simple alkyl groups are known to increase the carcinogenic activity of certain parent hydrocarbons. It is also known that the position of the substituent on the ring system is rather critical.

The identification of these substances in polluted air is a very difficult problem, see for example, [V. C. Shore and M. Katz, Anal. Chem., 28, 1399 (1956)]. Independent, unequivocal synthesis of some of these compounds would obviously lessen the problem.

The most generally available methods for synthesizing alkyl substituted polynuclear aromatic hydrocarbons often lead to mixtures of products of somewhat questionable structure. The research we wish to discuss involves the synthesis of pure samples of alkyl dibenzpyrenes of known structures by a rather general reaction sequence which places the alkyl groups in known positions on the aromatic moiety. The method of synthesis will be evaluated in view of the recent paper of M. Zander [Ber., 92 2749 (1959)] dealing with a new synthesis of polynuclear aromatic hydrocarbons.

THE MECHANISM OF THE OXIDATION OF FREE RADICALS AT 25°C. IN O_2-RICH MEDIA

JACK G. CALVERT

Chemistry Department, The Ohio State University, Columbus, Ohio

The reaction of simple organic free radicals, generated photochemically, in oxygen-rich media has been studied through the use of flash photolysis, long-path infrared spectrophotometry, ultraviolet spectrography, mass spectrometry, and gas chromatography. The rate constant for the reaction, $CH_3 + O_2 + M \rightarrow CH_3O_2 + M$, was evaluated in the flash studies. The analogous reaction with C_2H_5 radicals is now under study. Product rate studies with the methyl radical system show that CH_3OH and CH_2O are the major products of the CH_3-O_2 reactions. Considerable evidence, both indirect and direct shows ozone is generated as a transient product in the CH_3-O_2 systems. Its formation is considered in terms of the reaction, $CH_3O_2 + O_2 \rightarrow CH_3O + O_3$. Rate data from the photolysis of azomethane-CH_2O-O_2 system suggest a very high value for the rate of the methoxyl radical disproportionation reaction, $2CH_3O \rightarrow CH_2O + CH_3OH$.

A NEW OXIDANT IRRADIATION CHAMBER

ROBERT R. AUSTIN

Robert R. Austin Laboratories, San Gabriel, California

A new oxidant irradiation chamber has been developed as a part of our work under Public Health Research Grant S-86. This 8-liter cylindrical chamber, irradiated by four 40-watt fluorescent ultraviolet lamps, can replace the 50-liter chamber, irradiated by four 400-watt ultraviolet lamps. The 50-liter chamber has been widely used in air monitoring applications and has shown the need for reduced power consumption and residence time of the air sample in the chamber.

Chamber design is discussed and data are given for the performance of the new chamber, as compared to the 50-liter chamber, using mixtures of various hydrocarbons and nitric oxide in air, automotive exhaust mixtures in air and natural atmospheric samples. These data show that with the more reactive hydrocarbons such as the olefins, higher oxidant levels are reached in the small chamber, while with saturated hydrocarbons, lower oxidant levels are reached in the small chamber. Atmospheric samples and automotive exhaust samples give approximately equivalent oxidant levels in the two chambers.

OXIDATION OF ORGANIC COMPOUNDS IN THE ATMOSPHERE

LYMAN A. RIPPERTON

The University of North Carolina, School of Public Health, Chapel Hill, North Carolina

A system for the experimental study of atmospheric oxidation of organic compounds in concentrations found in urban atmospheres was constructed and some of its operating characteristics were determined.

Preliminary results utilizing a mixture of NO_2 (1 ppm) and hexane-1 (2 ppm) irradiated with floodlights showed no detectable ozone and very slight traces of "oxidant". Phenol was apparently produced. Freezeout and filter samples have been obtained and are being analyzed.

REACTIONS OF OXYGEN ATOMS WITH BUTADIENE

R. J. Cvetanovic

Division of Applied Chemistry, National Research Council, Ottawa, Canada

Better understanding of the complex chemical processes occurring in polluted urban atmosphere requires extensive background knowledge of numerous elementary reactions, based on detailed studies of the course and the rates of such reactions under a variety of conditions. As a part of the efforts to accumulate such information, reactions of oxygen atoms with a number of different types of organic compounds have been investigated over a number of years in the laboratories of the Applied Chemistry Division of the National Research Council in Ottawa and this work is still in progress. The reactions of oxygen atoms with olefins are of particular importance since their role in the photochemistry of polluted urban atmosphere appears now to be well recognized. The main features of these reactions are now understood and their rates are known with considerable certainty.

The reaction of oxygen atoms with butadiene (studied in collaboration with Mr. L. C. Doyle) illustrates particularly well one important feature of the reactions of oxygen atoms with olefins. This is the formation of "hot" (energy rich) products in the initial stages of these processes as a result of high heats of reaction. The main products of the reaction of oxygen atoms with 1,3-butadiene are butadiene monoxide and 3-butenal, in agreement with the general mechanism established for olefin-oxygen atom reactions. However, these products are "hot" and at low total pressures they undergo extensive decomposition. Collisional stabilization of these "hot" products can be followed quantitatively in the absence of molecular oxygen as the pressure in the system is increased up to one atmosphere. This behavior is very similar to that of propylene and the two compounds have about the same number of degrees of freedom. The products from ethylene, on the other hand, exhibit very little collisional stabilization, while those from butenes and heavier olefins are deactivated at pressures of the order of 10 mm and lower. It is believed that in the presence of large amounts of molecular oxygen, as under conditions existing in the polluted atmosphere, large fractions of the "hot" products instead of being deactivated, can undergo reactions with molecular oxygen, simulating to some extent ozone-olefin reactions. Such processes are likely to play an important role in the polluted urban atmosphere.

THE DESIGN OF EPIDEMIOLOGICAL INVESTIGATIONS OF COMMUNITY AIR POLLUTION

JOHN J. PHAIR AND THEODOR D. STERLING

Department of Preventive Medicine and Industrial Health, College of Medicine
University of Cincinnati, Cincinnati, Ohio

The search for reliable and universally acceptable standards for the control of community air pollution primarily dependent on, or related to effects on man's health has proven extraordinarily difficult. Several avenues have been suggested, namely: The experience of industry with specific compounds; the description of limited local or community problems; and exposures under controlled conditions in the experimental laboratory. It is readily apparent that well conducted epidemiological investigations finally must be connecting links, assembling and interpretating the observations obtained from each of these approaches. The design of these projects is not simple because of many factors.

The experience of the Department of Preventive Medicine and Industrial Health between 1952 and 1958 is reviewed briefly. This includes planning of various aspects of the project and reasons for the choice of methods employed both in the follow-up of patients and measurement of their environment. The results of three very exploratory trials are utilized. In these, the hypothesis tested was essentially: "Fluctuation in air pollution as measured by the soiling of filter paper and in the third trial, the total gaseous acid present as well, are negatively correlated with variations in the patient's well being as assessed subjectively by diaries and questionnaires and objectively by measurements of pulmonary efficiency".

It was hoped that a specific association would be demonstrated between environmental conditions and patient response by obtaining reasonable exact estimates of their physical conditions at regular intervals within a defined period of time and in turn, relating these findings with the variations in air pollution observed in their immediate surroundings. If this goal had been completely attained, the many suggested methods for describing man's reactions to the ambient atmosphere then could be more easily compared and critically evaluated.

METHODS AND RESULTS IN THE NEW ORLEANS ASTHMA STUDY

ROBERT LEWIS

Biostatistics Department, Tulane University School of Medicine, New Orleans, Louisiana

Over the past several years outbreaks of acute respiratory embarrassment, generally diagnosed as "asthma", have been noticed in the Charity Emergency Center in New Orleans. The Emergency Center is the only free clinic of its type in the city, its clientele are for the most part Negro, and there is a consistent daily admission for asthma such that in the past two years there has not been a day with less than 5 admissions for emergency asthma treatment at the Center.

The age, race, sex, place of residence, and time of admission were collected from record books for asthma admissions in 1958. A deck of machine record cards were obtained from the U. S. Weather Center representing the hourly surface observations at Moisant Airport. The two records were collated to associate hourly surface weather observations with admissions during the succeeding hour.

Analyses of these data showed apparent relationships between wind speed, wind direction, season, and age group for Negro admissions. Younger age groups tend to respond to light variable winds and calm conditions, with little seasonal variation apparent. Older age groups tend to respond to light directional winds with somewhat more response in the summer season than in the winter season.

Wind direction appears associated with geographic regions of the city, with the most effective wind lying from the directions between South and West - Southwest. For persons residing in certain regions asthma onset appears to be associated with northeast winds. Three "suspect" areas are defined. It may be that emanation of air contaminants from these areas affect persons susceptible to asthmatic attack.

Epidemiologic study of two current outbreaks in 1959 tend to confirm the impressions from the 1958 data.

ESTABLISHING A STATE-WIDE AIR SAMPLING SYSTEM

V. H. SUSSMAN

Pennsylvania State Health Department, Harrisburg, Pennsylvania

The recently enacted State-Wide Air Pollution Control Law provides that one of the duties of the Pennsylvania Department of Health is to "Determine by means of field studies and sampling, the degree of air pollution existing in any part of the Commonwealth". It seems clear that the legislative intent of this provision is that the Department of Health maintain a surveillance sampling program. A study of how best to implement this provision considered three approaches:

1. A random sampling method with some bias towards problem areas.

2. Maintaining sampling equipment in regional offices of the Department of Health for emergency use or specific studies.

3. Area and community studies, involving sampling, source inventories and calculations of area pollutant levels.

The experience of the Department of Health in employing these three survey methods is reported. Information on pollutant levels during and after the recent steel strike, obtained using the regional office method, will be discussed. Sampling and inventory techniques used in area and community studies will be outlined. An evaluation of the applicability of various survey methods is presented.

MEDICAL PHASE OF THE NASHVILLE AIR POLLUTION STUDY

L. D. ZEIDBERG

Vanderbilt University, School of Medicine, Nashville, Tennessee

As part of a joint medical and engineering study of air pollution in Nashville, four separate but related medical programs were developed. These included a morbidity survey of a randomized sample of the population, comprising approximately three thousand households; a mortality study of approximately twenty-five thousand deaths occurring in Nashville and Davidson County during the period 1949 to 1956; a clinical study of one hundred and twenty-three individuals with known chronic cardiorespiratory disease; and an anthracosis study of six hundred and forty-one individuals over five years of age who were autopsied at Vanderbilt University Hospital between 1953 and 1956.

The present paper includes a brief description of the methods and materials of each study together with a report of the preliminary analyses of the anthracosis study.

THE NASHVILLE AIR POLLUTION STUDY - ENGINEERING ASPECTS

J. J. SCHUENEMAN

Robert A. Taft Sanitary Engineering Center, USPHS, Cincinnati, Ohio

The Public Health Service Air Pollution Medical and Air Pollution Engineering Programs have conducted a joint study of air pollution in Nashville, Tennessee, with the School of Medicine of Vanderbilt University. Objectives of the study were to investigate possible relationships between air pollution and the health of people and to obtain information on a number of aspects of the engineering and meteorological aspects of air pollution.

Objectives of the engineering and meteorological studies are described. Aerometric studies are discussed in terms of equipment used and analytical methods employed. Other activities are outlined, including preparation of a sulfur dioxide emission inventory, a sampling of public opinion on air pollution, and forecasting of pollution levels.

COMMUNITY CASES OF BERYLLIUM DISEASE

JAN LIEBEN

Division of Occupational Health, Pennsylvania Department of Health, Harrisburg, Pa.

Beryllosis or beryllium disease is briefly described. Three groups of neighborhood cases which have been reported on are reviewed. Each group of cases appears to have features which make it different from the other. One group was from the fluorescent industry and two groups are from the beryllium refining plants. Differences of study methods, evaluation, topography, and meteorological conditions are analyzed. There are many unanswered questions concerning this disease, and since it is one of the few, if not the only, chronic non-cancerous disease allegedly caused by air pollution further extensive studies are needed.

Maximum allowable concentrations are discussed.

CALIFORNIA'S AIR POLLUTION STANDARDS

JOHN R. GOLDSMITH

State of California Department of Public Health, Berkeley, California

The 1959 California Legislature called on the California State Department of Public Health to develop standards for the quality of air of the state, and the maximum allowable standards for motor vehicle exhaust emissions.

These standards were adopted by the California State Board of Health on December 4, 1959, and called for a limit of hydrocarbons and carbon monoxide in emitted exhaust. Legislative implementation will be considered at a special legislative session in March, 1960.

A number of important decisions had to be made. Of foremost importance was the decision to base standards only on available data and to seek review by out-standing authorities.

Ambient air standards were set at three levels. "Adverse" levels of air quality are those at which there would be sensory irritation, damage to vegetation, visibility reduction or similar effects. "Serious" levels are those at which there would be alteration of bodily function or which are likely to lead to chronic disease. "Emergency" levels are those which are likely to lead to acute sickness or death in sensitive groups of persons.

The air quality standards are based on principles of toxicology applied to the community. Among the problems considered are the choice of population groups to form the basis for standards, the effects of multiple exposures and multiple pollutants with similar effects, the determination of a significant toxic increment, and the effects of long-term low-level exposures.

The standard setting program is viewed as an application of preventive medicine in the field of air sanitation. The program will need to develop standards for other substances such as lead and carcinogens. Standard setting has proved to be a potent stimulus and guide to research in air pollution.

MEETING FACILITIES LOCATION MAP
NEW ORLEANS, LOUISIANA

HOTELS

1. JUNG HOTEL
2. NEW ORLEANS HOTEL
3. LA SALLE HOTEL
4. ROOSEVELT HOTEL
5. DE SOTO HOTEL
6. ST. CHARLES HOTEL
7. MONTELEONE HOTEL